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SYPHILITIC LEPTOMENINGITIS *

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With Plates 1 to 11

The only unanimity among the writers on syphilis of the central nervous system, with respect to the various forms of syphilis of the meninges, is the recognition by all of a gummatous meningitis. The spreading exudative leptomeningitis, generally accepted as the commonest form of syphilis of the meninges, has a number of names, for example, diffuse gummatous meningitis (Oppenheim), fibrohyperplastic syphilitic meningitis (Nonne), and "méningite sclérogommeux" (Sézary). The terms, disseminated, diffuse, circumscribed, and mixed, are used with reference to distribution of the lesions and need no comment. In short, syphilis in this part of the body is characterized, as it is usually elsewhere, by focal lesions, the gummas. Various names have been applied to the disease because of the variations in size and location of the gummas and the extent to which they may or may not be accompanied by inflammation, spreading out from their periphery and perhaps coalescing to form more or less of a fibrinocellular exudate, which varies in its character according to the degree of acuteness and of healing.

REVIEW OF THE LITERATURE

Sézary[1] classifies syphilitic meningitis according to the principles which govern the general pathology of syphilis: Secondary syphilitic meningitis, characterized by diffuseness and generalization of the process with a tendency to resorption; tertiary meningitis, characterized by circumscribed lesions with a tendency to necrosis and fibrous thickening; "residual," "metasyphilitic," or "parasyphilitic" meningitis, which accompanies dementia paralytica and tabes. According to Sézary, the latter form of meningitis is not syphilitic.

In text-books we generally find a description of the basilar exudative form. Oppenheim[2] states: "I do not hesitate to call diffuse basilar syphilitic meningitis the most common form of syphilitic affections of the brain. . . . The base looks as if some solidifying fluid, like paraffin, has been poured over it. The entire base, or chiefly the interpeduncular space and the region of the optic chiasma, are thus involved. The mass penetrates into all fissures and recesses, so that the basal structures are more or less hidden by it. Also, the roots of

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[1] Jour. de méd., Paris, 1913, 7, p. 201.

[2] Berl. klin. Wchnschr., 1889, 26, p. 1033.

the cranial nerves are imbedded in this substance. The new formation is gelatinous, or slightly elastic in consistency. In some places, it forms a tough plaque of connective tissue which is intimately adherent to the basal portions of the brain."

Meningitis of the convexity is considered as of much rarer occurrence. "The same process of a gummatous meningitis, sometimes circumscribed, sometimes spreading over a considerable area, may develop on the convexity of the brain, tho not so often as at its base. In the former case, it penetrates more or less deeply into the tissue of the brain and thus affects the functions. It has also been observed that the same process may involve the base and the convexity of the brain simultaneously" (Oppenheim). In fact, reports often mention an occasional involvement of the membranes of the convex surface of the brain or a milky opacity of the vessels in the fossa Sylvii, but it is frequently represented as an extension from the base.

Besides nomenclatures, there are other phases of the disease about which the authors differ. Oppenheim writes as follows: "I want to emphasize the fact that syphilis is rarely limited to the spinal cord; in the majority of cases it is of the type of a cerebrospinal involvement . . . so that I may designate diffuse syphilitic cerebrospinal meningitis as the most frequent form of syphilitic diseases of the central nervous system." Nonne's observations on this point, however, are: "In my material, I have never seen this extensive and high grade gummatous involvement of the spinal cord and base of the brain which plays such a great rôle in the literature, and I may state here that all the experienced specialists, of whom I have made inquiries concerning this, have convinced me that these 'classical cases of a gummatous cerebrospinal meningitis' must be very much rarer now."

Recently, a form of syphilitic meningitis, which is not a new type but which has unusual and interesting features, has been discussed under the heading of "nodular" syphilitic meningitis, or syphilitic meningitis with "nodule formation." Nodule means here the small nodule ("Knötchen") which macroscopically does not differ grossly from the tubercle and which for this reason has given rise to difficulties not solely of nomenclature, but also, in some instances at least, of interpretation of the disease. The larger nodule ("Knoten") has such distinctive features that differentiation between it and the tubercle does not really present any difficulty. Baumgarten has demonstrated this very clearly in an interesting report of syphilitic meningitis in a man who also had well-defined pulmonary tuberculosis. There were miliary nodules ("Knötchen") in the lung as well as nodes in the meninges, but minute nodules could not be detected in the latter.

Regarding Baumgarten's report Nonne[4] states: "I could not find a similar case in the literature; hence this degree of multiplicity (of gummas) is, at all events, a very rare one." In the brain Baumgarten studied, the lesions were located on the base on the midbrain, the circulus Willisi, the left half of the pons, and the adjoining portions of the cerebellum and medulla oblongata, and isolated nodes were found in various parts of the basal arachnoid of the cerebral and cerebellar hemispheres.*

This nodular ("knötchenförmige") syphilitic meningitis seems to be a rare variety of the disease. Dürck's[5] report (in 1908) of five cases of this type, which aroused a great deal of discussion and controversy, was followed by reports by

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* The numbers of lesions in Brain 32 of our series considerably exeed those reported by Baumgarten.

[3] Virchows Arch. f. path. Anat., 1881, 86, p. 179.
[4] Syphilis und Nervensystem, 1909, p. 38.
[5] Verhandl. d. deutsch. path. Gesellsch., 1908, 12, p. 211.

Versé of one case (1908); by Albrecht of two cases (1908); by Beitzke[6] of three cases (1911), who stated that small nodules in syphilitic meningitis had been mentioned in the literature before Dürck, but that their occurrence had been overlooked or forgotten; and by Sugi[7] of one case (1912). The small nodules observed by Dürck were mostly on the base, but also along the vessels in the fossa Sylvii, and, in two cases of hereditary syphilis, they were also on portions of the convexity. In Beitzke's cases, the nodules were on the base and in the fossa Sylvii in two cases, but in the third case they were entirely on the convexity. The brain which Sugi described had nodules in some places on the base and medulla. The size of the nodules was variable: in Dürck's cases they were the size of a millet seed or somewhat larger; in Beitzke's, they were the size of a poppy seed in one, submiliary in another, and unequal in size in the third; in Versé's case they were miliary; and in Sugi's, the size of a pinhead. The number of the nodules also varied: in three of Dürck's cases, in one of Beitzke's cases and apparently also in Versé's case they were numerous, while in Sugi's case they were rather scanty.

Microscopically, there are three main sorts of alteration: the focal lesions; the more widely spread, chronic, hyperplastic inflammation; and the vascular changes. Very frequently, there is a combination of these. A combination of the multiplicity of lesions, the evidences of old and new processes, the appearance and disappearance of conditions, degeneration, regeneration, and absorption, is the pronounced microscopic feature. Nonne[4] points out that in the leptomeninges we "hardly ever miss the combination of the simple hyperplastic form of the acute and chronic inflammation with gummas, more recent processes side by side with later stages, all of which demonstrates so well the chronicity and the tendency peculiar to syphilitic processes to reappear in new crops. . . . The less the inflammatory congestive element prevails, the more evident are the specific neoplastic formations, which, on the other hand, are less pronounced, the more acute the inflammation is, because more time is needed for productive activity." Where the gummatous form is pronounced, the normal configuration of the pia-arachnoid is more or less effaced. Poorly stained areas are filled with degenerated cells and amorphous masses, and giant-cells may be found here and there. Vessels are altered, obliterated, or entirely reorganized, so that remnants of elastic fibers may be all that denotes the vessels' former location. Hyperplasia of the connective tissue is nearly always present; the thickening may be considerable and involve all the trabeculae, longitudinal and oblique. Between these strands there are foci of round-cell infiltration, small or extensive, within the pia along the surface of the brain, or around the vessels, or enclosed in the meshes of the arachnoid membrane and of the subarachnoid space. A close connection with the vessels is generally in evidence; the lymphocytes frequently occupy the adventitial spaces and may form more or less regular coats around the vessels. The immediate neighborhood of vessels is also the place of predilection for small gummas. These may be simply dense, round accumulations of lymphocytes or they may have epithelioid cells and may show within their centers all stages of caseation from beginning karyorrhexis to complete necrosis. Around the centers are radially arranged, epithelioid cells. Giant-cells may be absent or present, scanty or abundant.

Stursberg[8] describes a brain of which the pia was normal macroscopically, as were also the vessels at the base and the arteriae fossae Sylvii, but, microscopically, a very extensive involvement of almost the entire pia was found.

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[6] Virchows Arch. f. path. Anat., 1911, 204, p. 453.

[7] Wien. klin. Wchnschr., 1912, 25, p. 1827.

[8] Deutsch. Ztschr. f. Nervenh., 1910, 39, p. 459.

The processes were chiefly of an inflammatory nature and consisted of diffuse round-cell infiltration of varying degrees continuing into the nerve tissue as a perivasculitis. Besides these recent processes, there were here and there considerable thickenings of the connective tissue. There were no gummas. The pial arteries were only slightly involved, but the veins were thickened and infiltrated with round cells. Cases of this sort, a diffuse infiltration without gummas, are also described by Möller[9] and Finkelnburg[10] Dürck[5] describes peculiar, large cells, chromataphores, which occur normally in the leptomeninges, but are sometimes greatly increased in syphilis. They often have long and stellate processes and are filled with fine granules of yellowish brown pigment.

The giant-cells, not infrequently formed in gummatous meningitis, have been the subject of discussion. Baumgarten[8] considers giant-cells in a granulation tissue as indicative of tuberculosis, but there has been so much convincing evidence of their occurrence in syphilis that Baumgarten stands practically alone with his view. Beitzke quotes two of his three cases which show that giant-cells are rare in old gummas, but are numerous in fresh gummas.

In text-books, the word "gumma," or "gummatous," is invariably linked with the term syphilitic meningitis and the impression is that syphilis of the meninges means gummas in the membranes. On the other hand, in journals there are reports of syphilis of the meninges with no mention of gummas. This discrepancy proves however to be only apparent, for the term "gumma," or "gummatous," is used rather vaguely. What one writer describes as a diffuse infiltration, another refers to as a gummatous infiltration, and a third one calls gumma.

Ziegler[11] speaks only of gummas and syphilitic foci: "At the beginning of the disease a circumscribed inflammation occurs in the pia and the subarachnoid tissue which soon leads to the formation of a gray, or reddish gray, slightly translucent, sometimes gelatinous, granulation focus. The gummatous foci may be simple or multiple. A single focus may be very small — more frequently, however, there are larger foci, called gummas. On the surface of the cerebrum they generally extend in the sulci and consequently show their configuration. In the fossa Sylvii they occur in the form of streaks, while over the brain and spinal cord they form variously shaped, flat foci. In rare cases, a more diffuse infiltration of the membranes at the base of the brain has been observed." Adami[12] mentions the formation of gummas and the involvement of the vessels as the two main features of syphilitic leptomeningitis. "The gummas may be single or multiple and are not infrequently localized in a comparatively small district. It is moreover not uncommon to find definite large masses of them or diffuse gummatous infiltration." Kaufmann[13] describes basilar gummatous meningitis as the usual form of brain syphilis, consisting in the formation of crcumscribed solitary or multiple specific inflammatory foci or in a more diffuse specific tissue formation within the membranes. Nonne[4] states: "Where the meninges become involved primarily we have the gummatous form, and this gummatous change reveals itself either as a diffuse infiltration or as a miliary focus within the fibrous thickenings of the membranes." Naturally, there are authors who question the propriety of using the term gumma for conditions fundamentally the same but which differ considerably in microscopical appearance. Meyer[14] writes: "The gummatous infiltration of authors is no gumma in the proper sense. According to the view of many, it is true, the diffuse cellular new formation forms the anatomical basis of the gumma, but diagnostically there is undoubtedly a considerable difference between the more or less sharply deliminated new formation with the various metamorphological forms and, for example, the diffuse cell infiltration which extends throughout the entire pia . . . Where the tendency to circumscribed tumor formation within the diffuse infiltration is very pronounced, the term gummatous infiltration might be retained."

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[9] Hygiea, 1894, 56, p. 85.
[10] Deutsch. Ztschr. f. Nervenh., 1910, 39, p. 459.
[11] Lehrbuch der speziellen pathologischen Anatomie, 1892, p. 369.
[12] Principles of Pathology, 1911, 2, p. 575.
[13] Lehrbuch der speziellen pathologischen Anatomie, 1911, 2, p. 1162.
[14] Zentralbl. f. allg. Path. u. Path. Anat., 1898, 9, p. 746.

Another point of discussion is the question of the primary natures of gumma and gummatous infiltration and meningitis and gumma in the brain. Boettger[15] believes that the gumma does not result secondarily from the cellular infiltration but that the latter frequently follows the gumma. Quincke[16] states: "The longer lues exists the more does the meningitis become circumscribed and, at the same time, poorer in cells; the terminal phase is the meningeal gumma; between this and the initial serous meningitis there are many intervening stages . . . but the meningeal gumma like any other focal lesion, may temporarily give rise to an acute serous inflammation." Virchow, Heubner, Buttersack, and Schultze consider a "simple meningitis" the result of regressive changes of gummatous processes.

The meningeal origin of gummas in the brain is practically agreed upon by all, and also that the gummas may again be the origin of a meningitis secondarily. There is no connection between the gummas of the brain and the specific nerve tissue, tho the latter is nearly always affected secondarily more or less severely.

The second type of change, chronic hyperplastic inflammation is probably present in some degree in all cases of syphilitic meningitis. The presence of fibrous thickening in the form of more or less extensive plaques, gray, white, or yellowish, located in various regions of the brain, or microscopically an increase in the connective tissue is generally mentioned but not discussed in descriptions of syphilitic meningitis.

Some authors claim that the changes in the meninges due to alcoholism may appear similar to those from chronic syphilis. They assert that the plaques of thickening found on the convexity, chiefly along the intercerebral fissure, and the grayish, whitish, or yellowish white masses of opacity in the pits formed by sulci are found as well on the brains of chronic alcoholics as on those of syphilitic subjects. This assertion, to be of any value, must be founded on actual observations supported by very accurate, clinical data and reliable histories. Of course, alcohol is one of the most important contributing causes of death in cerebral syphilis, for example, Tarnowsky[17] found that of one hundred individuals with syphilis of the central nervous system, twenty-nine were cases of neurasthenia; six of overwork; five, head traumas; and forty-three alcoholism. Many writers (Oppenheim, Kahane, and Hjelmman) state that alcoholic excess or chronic alcoholism is the history in many cases of brain syphilis. It is difficult to see how in these cases a separation of lesions from both sources could be done with any accuracy. As both affections are of a decidedly chronic nature, one resulting from the constant reintroduction of alcohol into the system and the other due to the constant flaring up of the infectious foci in the system, it must be supposed that the lesions are intermingled and superimposed. The physiognomy of alcoholic meningitis cannot be learned from hybrid forms, and therefore the lesions of purely alcoholic and purely syphilitic origin must be sharply separated from those of chronic alcohol-

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15. Quoted from Meyer: Zentralbl. f. allg. Path. u. path. Anat., 1898, 9, p. 746.
16. Deutsch. Ztschr. f. Nervenh., 1909, 36, p. 379.
17. Arch. f. Dermat. u. Syph., 1891, 23, p. 384.

ism in syphilitic individuals, on the one hand, and of brain syphilis in alcoholic subjects, on the other.

The histological picture of alcoholic meningitis which Meyer[18] gives would rather indicate a decided morphological difference between the two conditions: "The thickening of the pia is a hyperplastic, and not an infiltrative, condition. There is an increase in the connective tissue which occurs in masses of loose fibers; the scattered cells appear morphologically as connective tissue cells. Plasma-cells and lymphocytes, in considerable number at any rate, cannot be demonstrated." Other accounts mention vascular changes, as fibrous thickening of the wall and hyaline degeneration in the pia and brain substance and a slight periarteritic increase in the cells. In a monograph by Rose,[19] in 1884, on delirium tremens there is no account of any special meningeal changes due to alcohol, and his observation was that the characteristic feature of acute alcoholism (delirium tremens) is edema, not turbidity of the meninges. He states: "Where death occurs in delirium tremens itself, edema is the marked feature; the more often delirium tremens repeats itself, the longer all the forms of chronic alcoholism persist, the greater is the turbidity of the pia and the atrophy of the brain."

Animal experiments with alcohol poisoning do not convince us that there is any particular similarity in the lesions produced by the alcoholic poison and those caused by the syphilitic virus. First of all, it must be mentioned that the results of these experiments have not been uniform. The microscopic changes which Lissauer[20] found in two of four rabbits were perivascular infiltrations, consisting of lymphocytes and plasma-cells. There were no gross lesions in the meninges of these two animals. In the other two rabbits, the membranes were normal. Montesano[21] reported a perivascular infiltration with plasma-cells. Ferrari[22] found thickening and infiltration of the meninges in guinea-pigs fed and injected with alcohol and similar changes in the offspring of the animals. Lissauer mentions the changes found by other investigators, as by Braun of an inflammatory infiltration of the pia, by De Rechter of hyperemia and thickening, by Afanassajew of fat infiltration and cells with fat granules in the pia, and by Ruge of engorgement of the vessels and slight edema. Fahr[23] found no changes macroscopically or microscopically in eight guinea-pigs which had been fed with alcohol for two years.

Whether or not the involvement of the vessels is to be considered the direct starting point of syphilitic processes in the meninges and secondary to those in the brain, changes within or around the vessel walls are as a rule a conspicuous feature of syphilitic meningitis. Without entering into the controversies regarding the specificity or non-specificity of the vascular lesions found in syphilis of the nervous system, it may be stated that Heubner's endarteritis has not been observed unaccompanied by chronic meningitis except with tumor. This disease is frequently syphilitic on account of certain peculiarities, such as the absence of calcification, caseation and fatty degeneration, the tendency to focalization, and the splitting or reduplication of the elastica interna. There is some difference of opinion as to whether the doubling of the elastica is due to the splitting of the old one or to the formation of a new one and where the starting point of this process is to be sought. Marchand believes that the second elastica is formed by a splitting of the old. Dürck convinced himself, by Weigert's stain for medullary sheaths, that the new elastica is not a splitting process but a new formation, independent from the old elastica. This author also expresses the view, that it is not the endothelium itself which participates in the proliferation of the intima, as Heubner believed, but the so-called cellular layer, which is situated between the membrana fenestrata and the endothelium. According to him, the giant-cells, which are nearly always in the immediate neighborhood of the elastica interna, start from the Langhans' layer.

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[18] Quoted from Lissauer: Centralbl. f. allg. Path. u. path. Anat., 1913, 24, p. 337.
[19] Delirium Tremens und Delirium Traumaticum, Deutsch. Chirurgie, Stuttgart, 1884.
[20] Centralbl. f. allg. Path. u. path. Anat., 1913, 24, p. 337.
[21] Centralbl. f. Nervenh. u. Psychiat., 1907, 18, p. 849 .
[22] Monatschr. f. Psychiat. u. Neurol., 1910, 28, p. 483.
[23] Verhandl. d. deutsch. path. Gesellsch., 1909, 13, p. 162.

With all the similarity between tuberculous and syphilitic lesions in general, there are nevertheless rather distinctive features in the vascular changes in these two affections. A clear distinction of the cerebral vessel changes in syphilis from those in tuberculosis is made by Beitzke,[24] who states: "In syphilis . . . we have in the main a panarteritis, a cell infiltration consisting chiefly of round cells and starting from the adventitia or the adventitial lymph sheath; and anatomically independent from it a proliferation of the intima, consisting chiefly of cells with oval and spindle shaped nuclei; occasionally giant cells are found. Sometimes, however, the cell infiltration of the external coats breaks through the elastica interna, when it spreads in a fungus-like manner along the inner surface of the elastica; but the round cells of the granulation tissue can well be distinguished from the larger oblong cells of the thickened intima. If the process is advanced, only this thickening of the intima remains, with complete obliteration of the lumen, as the case may be. The infiltration of the media and adventitia has disappeared, leaving only small scars."

"In tuberculous meningitis there are likewise cell-infiltrations in the adventitia and media, which, however, consist chiefly of leukocytes with lobulated nuclei, even in chronic cases. Proliferation of the intima of the pial vessels is seen only to a limited extent; probably an obliterative tuberculous endarteritis scarcely ever occurs in the cerebral arteries. The occlusion is here produced by the tuberculous granulation tissue penetrating from without, which at first only lifts the endothelial membrane, then fills out the entire lumen, and finally undergoes caseation together with the arterial wall. The elastic fibers behave in an entirely different manner in the two infections. In chronic tuberculosis, the elastic membranes are generally totally destroyed or to a few remnants in the caseated portions, while in syphilitic caseation they can as a rule still be very nicely demonstrated. The formation of a new elastica interna, so frequent in syphilis, is never observed in tuberculous arteritis cerebralis."

Lesions in the arteries are not a constant feature nor are they the only vascular changes in the syphilitic processes of the meninges. Little is known regarding changes in the veins. In Stursberg's[8] case the arteries of the pia were only slightly involved in the inflammatory process, there were a few round cells in the external layers of the adventitia and no changes in the media or intima. The veins, however, were thickened, and infiltrated with round cells. Sträussler[25] found a marked infiltration both in arteries and veins in a case of syphilitic meningitis of the convexity in juvenile dementia paralytica.

A very interesting report from this standpoint was recently made by Versé[26] concerning a marked involvement of the veins of the convex surface of the under surface of the right temporal lobe and at the border of the left cerebellar hemisphere; microscopically, there was also a marked infiltration of the veins of the spinal cord. The case is particularly interesting as numerous spirochetes were found in various places in the walls of the veins, which furnished the author conclusive evidence of the mode of the invasion of the organisms. The rather frequent involvement of the cerebral veins may have a significance analogous to that given by some writers to the syphilitic involvement of the veins in other parts of the body. Rieder[27] from his study of seventeen cases of syphilitic stricture of the rectum, all marked by an extensive involvement of the veins with an almost complete intactness of the arteries, made this statement: "The syphilitic virus evidently has the property, not only of producing pathological processes in the places where it settles, but it attacks at once the vessels (veins and lymph channels) and progresses in nearly every case. The venous sclerosis marks, so to speak, for some distance the path on which it travels from the place of its entrance on to new foci and to dissolution in the general blood stream." A remark of Nonne is to this effect: "Cases suggest the thought that also in the central nervous system the veins are first involved specifically." Versé's report seems to be a confirmation of Nonné's supposition.

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[24] Jour. Exper. Med., 1896, 1, p. 467.
[25] Ztschr. f. d. ges. Neurol. u. Psych., Orig., 1912, 12, p. 365.
[26] Beitr. z. path. Anat. u. allg. Path., 1913, 56, p. 580.

As regards the lymph channels and the part they play in syphilitic affections of the meninges, Koester believes that the great thickening of the intima of the arteries may be due in part to an impediment to the conveyance of the nutrient material, since the lymph spaces are often displaced or also entirely blocked by inflammatory proliferations. Others, including Baumgarten, Friedländer and Ranvier, share this view. It is generally believed that the starting point of syphilitic processes is in the intra-adventitial and extra-adventitial lymph-spaces. The reciprocal effects from disturbances in the lymphatic system and processes that impede the blood circulation are probably of very far reaching consequences. Binswanger[28] has shown how the vessel changes and the resulting disturbances in the intra-adventitial and extra-adventitial lymph-spaces in paralytic dementia are intimately connected with the lesions in the nervous system. He demonstrated that the meningitis, which is present in most cases, and the hydrocephalus internus may also be attributed in a large measure to the alterations in the lymph stream, since the epicerebral space communicates with the intravascular and extravascular lymph-spaces and the former becomes obliterated where the pia becomes adherent to the cortex. Finally, it is possible that the chemically altered waste-products, which are eliminated from the vessels into the lymph-sheaths, injure, anatomically and functionally, the walls of the lymph channels and the nerve elements. Nonne[4] expresses practically the same view. Dürck[5] makes the frank statement: "The origin and spread of syphilitic meningitis is exclusively by way of the lymph channels and is not, as in tuberculosis, only a part of the phenomena of a general hematogenous nodular eruption."

The changes which have been described as characteristic of syphilis of the meninges, i. e., the gumma and the vascular changes, are processes which are generally classed among the so-called tertiary lesions of syphilis. Nowhere are the shortcomings and incongruities of Ricord's division of the lesions of syphilis more evident than in syphilis of the central nervous system. Neither have the attempts at classification by others been successful. As long as it was believed that syphilitic affections of the nervous system and its membranes were late manifestations of a syphilitic infection and that the rare exceptions were to be regarded as precocious cases, the fallacies of Ricord's, as well as Hutchinson's, division were not so obvious. But since the observations of a number of investigators have demonstrated that the contrary is more often the case, i. e., that syphilitic involvement of the central nervous system occurs very frequently at an early period of the infection, the confusion becomes almost distressing.

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[27] Arch. f. klin. Chir., 1897, 55, p. 730.
[28] Virchows Arch. f. path. Anat., 1898, 154, p. 389.

As Ogilvie[29] expresses it, "We are led to the paradox that a large majority of the tertiary phenomena occur in the secondary stage." Therefore, it seems best to avoid the terms "secondary" and "tertiary" in connection with brain syphilis, both in regard to time and to the pathological characteristics, for to quote Ogilvie again: "Another point of importance elicited from the post mortem statistics is that, with the exception of tabes and general paralysis, no syphilitic disease of the nervous system and membranes is peculiar to a certain age of the infection. During the first year after infection, gummatous disease and disease of the blood vessels with its consequences are not rare. On the other hand, disease of the baso-cranial nerves, generally considered of comparatively early appearance, is often met with in the latest stage. This result entirely coincides with the experience of Dr. Gowers, who says that disease of the arteries might occur at any time between the first and the twenty-fifth year after the chancre, altho usually before the seventh or eighth year, that whenever it occurs it is exactly the same in appearance, and that the gummatous lesions are less common, but are found at the same period of syphillis as the arterial lesions."

We have mentioned that very recently a classification of syphilitic meningitis upon the basis of the general classification of syphilis was attempted by Sézary[1] who believes that the same pathological characteristics and pathological tendencies which form the foundation of the latter can also be observed in the forms of syphillis of the meninges. "Secondary" syphilitic meningitis is subdivided by him into "latent," "frank" (avérée), and transitional, or "abortive" (fruste), forms. The first is only revealed by lumbar puncture and appears at the moment of the general eruption. According to Ravaut[39] its intensity is parallel to that of the eruption and it occurs in at least half of all cases of syphilis. The second form, "frank" meningitis, is rarer and corresponds to the acute syphilitic meningitis of other authors. The histological lesions are similar to those of the latent form. The general character of the lesions of tertiary meningitis corresponds to that of tertiary lesions; the author calls this type "scléro-gommeux." According to Sézary there is a similar relation between secondary and tertiary syphilitic meningitis as between the macules and papules and the gummas. A third type is called "residual," or "meta" syphilitic, or "parasyphilitic" meningitis, and is characterized by residual lymphocytosis which, having gradually diminished, arrives at a certain rate below which it cannot be brought, even with intense treatment. The meningitis associated with such a "residual lymphocytosis" is not the same as tertiary meningitis; it is not syphilitic according to Sézary, chiefly on the ground that treatment does not cure it, tho it is possible for it spontaneously to disappear slowly, like any other chronic meningitis, in the absence of treatment. Very probably, it is purely irritative and due to an inflammation kept up by the neighboring cicatricial focus and favored by the former meningeal lesions.

This classification would seem to lend meaning and precision to terms which apparently are so often ill-applied to syphilitic lesions of the central nervous system. The views expressed by the author leave room for discussion, however. If "secondary meningitis" sets in at the moment of the general eruption and the condition of the membranes during the secondary period depicts the general

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29. Lancet, 1895, p. 1368.

septicemia, or spirochetemia, the question arises why serous membranes other than the pia-arachnoid, for example, the pleura and the pericardium, are not similarly affected by the blood infection? Sézary states that "frank" syphilitic meningitis, characterized like the other forms of secondary syphilitic meningitis by generalized diffuse lesions with a tendency to resorption, corresponds to the acute syphilitic meningitis described by many authors. In consulting the literature on this point, we find that some of the reported early, acute cases have this diffuse infiltration, but other, and perhaps more, cases have circumscribed lesions in addition to the diffuse infiltration. A number of the group "nodular syphilitic meningitis" are acute cases. It is very questionable whether any sharp lines can be drawn. Sézary distinguishes the lesions of secondary syphilitic meningitis from those of tertiary syphilitic meningitis by the tendency of the former to resorption and of the latter to sclerosis and necrosis. If we admit that in many cases of secondary syphilitic meningitis resorption takes place, we must explain why all cases having the same tendency do not terminate in this manner. We have no proof that "tertiary" syphilitic meningitis starts entirely independent from any involvement of the membranes during the secondary period of syphilis and that its beginning, course, and termination are entirely different from those of "secondary meningitis.

Objections might also be raised against Sézary's views concerning "residual," "metasyphilitic" or "parasyphilitic" which, for reasons mentioned, he does not consider syphilitic. In the first instance, the terms "metasyphilitic" and "parasyphilitic" are, in such cases, out of place. Apart from the fact that these terms have lost their meaning and are being abandoned since the general recognition of the truly syphilitic nature of such conditions as tabes and dementia paralytica, the accompanying meningitis is purely irritative, and is neither syphilitic nor parasyphilitic. The new term, "residual," introduced by the author, which expresses its chief feature, "residual lymphocytosis," does not seem more appropriate, as it fails to emphasize the non-syphilitic nature of this type of meningitis. "Residual" still connects it with syphilis, of which it retains a residue, and "metasyphilitic" and "parasyphilitic" link it to metasyphilitic diseases or diseases now known as syphilitic.

We refrain from discussing the meningitis so frequently associated with the so-called "parasyphilitic" diseases. We shall merely menton some reports[30] of dementia paralytica in which true syphilitic lesions of the central nervous system and true syphilitic meningitis were found simultaneously with the lesions of paralysis.

The frequent and early involvement of the meninges in the course of syphilis has been recognized only in recent years and chiefly through the examination of the cerebrospinal fluid. Since the use of the Wassermann reaction we have become impressed by the great number of individuals with syphilis of the nervous system. Desueux, Dujardin and Weill[31] recently reported one hundred and sixteen cases of syphilis of the meninges observed within a period of twelve months. In some, the meningeal involvement was revealed by the "neurorécidif" reaction from the lumbar puncture and the reaction from treatment with salvarsan. The authors emphasize in particular the early involvement of the meninges in the course of syphilis. From the time of the generalization, i. e., about the third week, the meninges are affected with a peculiar constancy, and syphilis at this time is a real septicemia which attacks chiefly the skin and the nervous system. Gennerich,[32] from examination of the cerebrospinal fluid during primary syphilis, stated that the meningeal infection is evidently of general occurrence in fresh syphilis since the fluids from these cases, examined during the course of treatment, revealed a slight modification.

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[30] Sträussler: Monatsschr. f. Psychiat. u. Neurol., 1906, 19, p. 244; Ibid., 1910, 27, p. 20; Ztschr. f. d. ges. Neurol. u. Psych., 1912, 12, p. 365.
Plaut: Allgem. Ztschr. f. Psychiat., 1909, 66, p. 340.
Landsbergen: Monatschr. f. Psychiat. u. Neurol., 1911, 29, p. 147.
Giljarowsky: Ztschr. f. d. ges. Neurol. u. Psychiat., 1911, 6, p. 21.

[31] Jour. de méd. de Bordeaux, 1913, 18, p. 175.

The realization of this relation of the involvement of the central nervous system to syphilis came gradually. In 1786, Hunter[33] stated that he had never seen a case in which the brain was affected by syphilis and Astley Cooper believed that the brain was of those tissues which are not influenced by the venereal poison. About one hundred years later, Julien furnished statistics on tertiary syphilis and had 22 cases with nervous involvement in 224 cases of tertiary syphilis. Fournier, in 1890, published an account of 1,085 cases out of 2,600, in which syphilitic lesions were referable to the central nervous system. In 1892, Hjelmman gave statistics from 1,860 cases of tertiary syphilis, collected from all the divisions of the general hospital in Helsingfors, 1878-1890, in 254 cases of which the central nervous system was affected, and in 218 the brain alone. Tabes and general paralysis were not included in the list. Haslund reported 514 cases of tertiary syphilis, 133 cases among which involved the nervous system.

Hjelmman discussed the question of the increased frequency of brain syphilis and stated that syphilis itself has not increased, altho descriptions from older writers suggest the contrary. An actual increase in the frequency of syphilitic diseases of the nervous system, however, is believed by a number of writers. The cause of this increase is thought to be due rather to a change of the nervous system than to an increase of syphilis. The greater demand that is made on the brain for gaining a livelihood is thought to have influenced the nervous system, so that from generation to generation it yields more readily to the effect of the syphilitic infection. The relations between the inflictor and the inflicted seem to have changed in several respects. Bone lesions occupied at one time the first rank among the "tertiary" lesions. Sternberg, in 1860, writes: "Affections of the bones are becoming relatively rarer; on the other hand, syphilis seems to be more ruinous, graver, since it seems to attack now the inner organs, especially the brain, much more frequently." Also, Rumpf and others have called attention to the fewer bone lesions. The view expressed by older writers that syphilis of the central nervous system starts from lesions of the bones of the skull is in all likelihood based on erroneous premises and has nothing to do with the former observation. By later writers, no such relationship has been found by post mortem examinations.

Statistics of the frequency of brain syphilis cannot of course be made, but the statistics of the relative frequency are of more value. Fournier gives the following: tertiary syphilides, 787 cases, subcutaneous gummas, 428; tertiary lesions of the genital organs, 157; tertiary lesions of the tongue, 152; tertiary lesions of the velum palati, 179; tertiary lesions of the pharynx, 71; tertiary lesions of various mucous membranes, 30; bone lesions, 336; lesions of the nasal bones and of the bony palate, 137; arthropathies, 14; gummas in tendons, 3; gummas in muscles, 12; lesions of the digestive canal, 4; anorectal syphilomas, stricture of the rectum, 5; lesions of the larynx and the trachea, 23; lesions of the lungs, 14; lesions of the heart, 2; lesions of the aorta, 6; lesions of the liver, 9; lesions of the kidney, 9; lesions of the testicle, 145; lesions of the eye, 69; lesions of the auditory apparatus, 8; cerebral syphilis, 461; "accidents cérébro-spinaux," 11; monoplegias, 3; spinal syphilis, 77; tabes, 355; cerebrospinal tabes, 45; muscular atrophies, 19; general paralysis, 32; insanity, 9; ocular paralysis, 57; facial hemiplegia, 13; various nervous affections, 3; various affections, 8.

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[32] Quoted from Jacob: Ztschr. f. d. ges. Neurol. u. Psychiat., 1913, 19, p. 188.

[33] Cited from Hjelmman's monograph: On hjärnsyfilis, dess frekvens, kronologi, etiologi och prognos. Helsingfors, 1892.

Haslund examined 514 cases from the fourth division of the "Kommune" Hospital in Copenhagen. Here, also, "tertiary" syphilis is referred to: skin, 290 cases; nervous system, 133; bones, 131; mucous membranes, 96; inner organs, 22. Hjelmman's statistics from 1,860 cases are: lesions of the skin, 985 cases; lesions of the bones, 238; lesions of the nose and hard palate, 223; lesions of the pharynx and soft palate, 318; lesions of the larynx and trachea, 93; lesions of the genital organs, 50; lesions of the testicles, 32; lesions of various mucous membranes, 15; lesions of the eye, 32; lesions of the joints, 10; lesions of the liver, 32; syphilis of the brain, 218; syphilis of the brain and spine, 12; syphilis of the spine, 24; various lesions, 2.

In eighty-eight cases, Petersen found lesions in the liver in seventy-seven cases, in the kidneys in thirty-four, and in the brain in nine. Bernheim and Eichhorst state that of the inner organs only the liver competes with the brain. Nonne[4] gives the order in the frequency of the lesions as: arteries, kidneys, liver, and brain. According to Mauriac and Breus the greater number, according to Gaudichier and Hjelmman more than one-fourth, of the cases develop in the first year of the infection. Naunyn,[34] from the examination of three hundred and twenty-eight cases, came to the conclusions that 48 percent of the diseases of the central nervous system occur during the first three years, that after the number decreases from year to year, until after ten years the nervous system is only exceptionally involved. Rumpf[35] found that of forty cases of syphilis of the central nervous system nine developed within the first year. Mingazzini[35] reported eighteen cases from the literature and five of his own cases, in all of which cerebral manifestations occurred between one and one-half months to one and one-half years after the infection. Brasch[36] observed a case of brain syphilis which occurred six weeks after the primary lesion, while Nonne reported severe cerebral phenomena appearing with the secondaries. Quincke[37] reported a death from myelitis and cerebrospinal meningitis with clinically and anatomically a four-day course. The luetic infection had occurred three months previous to this. There was a slight, fresh leptomeningitis with hemorrhages into the meninges of the anterior part of the brain. Stursberg[8] observed severe nervous manifestations four months after the primary lesion with death two months later. There were still distinct signs of roseola. The microscope showed an extensive leptomeningitis with numerous small foci of softening in both hemispheres, caused by thrombosis of the smaller arteries. Two interesting cases are reported by Löhe.[38] In the first, the nervous involvement manifested itself three months after the initial lesion, when secondary skin lesions were still present, and, in spite of antisyphilitic treatment, death occurred. In the second, cerebral symptoms, as hemiplegia, occurred as early as twenty-four days after the primary infection before there were even slight secondary manifestations, while there were still the initial sclerosis and multiple indolent glandular swellings.

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[34] Mitt. a. d. med. Klinik z. Königsbrg i./Pr., Leipzig, 1888; Berl. klin. Wchnschr., 1888, 25, p. 870.

[35] Quoted from Löhe: Berl. klin. Wchnschr., 1910, 24, p. 1127.

[36] Deutsch. Ztschr. f. Nervenh., 1896, 8, p. 418.

[37] Ibid., 1909, 36, p. 343.

[38] Berl. klin. Wchnschr., 1910, 47, p. 1127.

Abnormalities in the cerebrospinal fluid, such as increase in the number of cells or in the protein content, have been found in primary syphilis. Altmann and Dreyfus[39] examined eight cases, in two of which there were positive Nonne-Apelt reactions, Phase 1, and cell-counts of eight and thirteen, respectively. In secondary syphilis the changes are frequent. Ravaut[40] examined one hundred and sixteen cases and found some abnormalities in 67 percent. Dreyfus[41] reported changes in all of the twenty-two cases which he tested. Fränkel,[41] in fifteen cases of early untreated secondary syphilis, found positive Wassermann reactions in five, Phase 1 in one, lymphocytosis in five, and counts of four to ten cells in four cases. In fifty-six cases of untreated secondary syphilis Altmann and Dreyfus[39] reported some increase in cells and globulin in 66 percent. Seven of these cases had cell counts of between seventy-five and one hundred cells, showed marked increase in the globulin content, and gave positive Wassermann reactions. This reaction was positive in five other cases of this group. Ellis and Swift[42] found abnormalities in 36 percent of twenty-two cases of untreated secondary syphilis and 100 percent in secondary syphilitic meningitis; four of these eight cases were treated.

Concerning the relation of dementia paralytica to the meningitis which so frequently accompanies it, a number of authors consider the anatomical lesions in this disease the result of a syphilitic condition of the lymph channels, blood-vessels, and meninges. The demonstration of spirochetes in the meninges as an aid in the diagnosis of the syphilitic nature of meningitis has so far played only a small part, as search for them has rarely been successful. In hereditary syphilis they have been found repeatedly. Strassmann, in 1910, was the first to demonstrate the organisms in the brain and spinal cord in acquired syphilis; Beitzke found them in one of three cases in 1911. In Strassmann's case they were seen wherever the inflammatory changes were dominant, in the large arteries, around the vasa vasorum, in large numbers in the adventitia and muscularis, very sparingly in the proliferated, not infiltrated, intima. They were always found in the proliferated vessel-walls of the diseased portions of the brain and medulla and were seen free in the tissue of the diffusely infiltrated and thickened meninges and in the infiltrated septa extending into the brain and spinal cord. "Their chief path of spreading," Strassmann states, "is at any rate connected with the course of the small vessels, in the lymph-sheaths and proliferated walls of which they apparently multiply." The spirochetes were found exclusively in the central nervous system. In Versé's case, reported in 1913, a few were seen in the testicles, but none in the other organs. Strassmann lays particular stress on the importance of the lymph stream for the multiplication and spread of the organisms. A similar view was expressed by Ranke who found spirochetes in the central nervous system in a number of syphilitic newborn children. Noguchi[43] who recently was so successful in finding the organisms in a large percentage of the brains of dementia paralytica, due to his modification of the Levaditi method, states that they were very rarely in the neighborhood of vessels or the vessel-walls, and that they were searched for in the pia, but could not be demonstrated with certainty.

Vanzetti[44] reported the transplantation of syphilitic material from the testicle of a rabbit into the subdural space of the brain of a rabbit, which resulted

[39] München. med. Wchnsch., 1913, 60, p. 264.
[40] Rev. mens. d. méd. int. et de thérapeutique, 1909, 1, 275.
[41] Quoted from Ellis and Swift: Jour. of Exp. Med., 1913, 18, p. 162.
[42] Jour. Exper. Med., 1913, 18, p. 162.
[43] München. med. Wchnschr., 1913, p. 737; Jour. Exper. Med., 1913, 17, p. 232.
[44] Arch. p. le sc. med., 1914, 38, p. 1.

in lesions in the dura, leptomeninges, and the brain substance near the inoculated fragments and at some distance and even in the other hemisphere, which were similar to lesions considered syphilitic in human brains. Search for spirochetes was always successful with reference to the transplanted pieces and always negative with regard to the lesions in the meninges and the brain. Noguchi[45] has also reported experimental work bearing on this question.

The following report is the result of the study of gross alterations in the meninges, or of changes visible with a low-power hand lens. As the changes in the meninges were frequently associated with syphilitic lesions elsewhere in the body, we believed that the meningeal lesions might have a syphilitic origin. The brains were not selected because there were luetic lesions elsewhere in the body, but all the brains possessing such changes were examined. These brains were found in successive post mortem examinations which extended over two years and five months. Mention is made of only the most significant changes in the anatomic diagnoses, and the lack of clinical details is due to the fact that, in most cases, the examinations (E. R. L.) were made for the coroner of Cook County on bodies of persons dying unexpectedly and without medical attendance. With only a few did the conditions permit of careful clinical observation and diagnosis. Unless otherwise stated, the interiors of the brains were found to be free from changes.

There are three main types of changes in the pia: opacity or turbidity; patches of fibrous thickening; and discrete focal lesions. Turbidity of the pia in some degree and extent is present in nearly all cases. The turbidity may be general and extend over almost the entire brain, shrouding it as with a veil or a sheet; the occipital lobes are usually unaffected. Sometimes, the turbidity appears only in patches, which are separated by portions of normal pia, while occasionally it is limited to one or two areas, and these may be small. Often the base is entirely free, but when it does exist there, it is marked over the pons, the interpeduncular space, and the region of the oculomotorius. The degree of opacity is also variable; it may be very slight and again it may be so marked that all the markings of the surface are masked, the sulci bridged over, the vessels only recognizable as dim, vague lines of a darker hue. When the opacity is prominent, the brain, if fresh, has a bluish white, dull hue, and appears as tho milk had been poured over it (Fig. 1). Otherwise it is grayish or pinkish gray. According to our observation, the opacity is much more frequently found over the convexity than on the base. It is generally pronounced over the fossa Sylvii; indeed, the two fossae or only one may be the chief or only locality where the pia is opaque.

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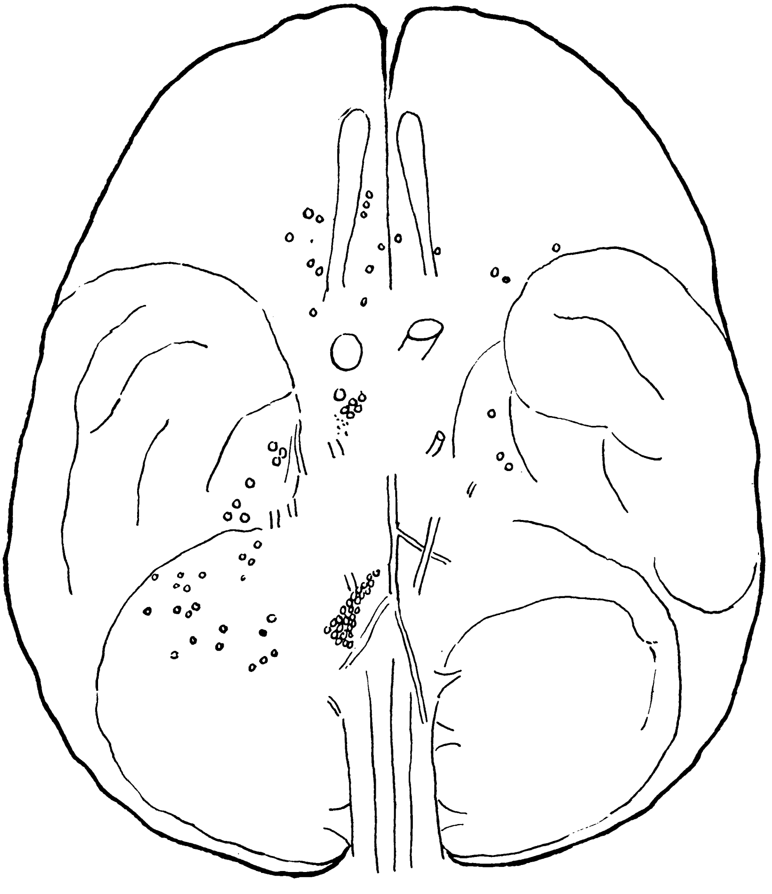
[45] Presse Méd., 1913, 8, p. 805.

Very frequently the second type of alteration, patches of fibrous thickening, are found in addition to the turbidity of the pia. These may appear as areas of a more or less diffuse white, or grayish white, dense thickening, more often along the intercerebral fissure, where it may extend along the entire length, except the occipital lobes as a rule, often being densest in the area bordering the median line. Frequently, there are circumscribed plaques of tough, dull white, or a glossy, yellow, bacon-like thickening, 1, 2, and 3 mm. in depth and 1, 2, and more cm. in length or width, also preferably in the area alongside the median line, the favorite seat of the pacchionian bodies, which may be found above, beside, or partially covered by them. Patches of a grayish, gelatinous, somewhat succulent thickening, generally of smaller dimensions, the size of a pea, bean, dime, or larger, may be seen in any locality, more on the convexity, not infrequently on the anterior pole of the frontal lobes, at the base on the anterior portion of the temporal lobes, and on the orbital lobes. These gelatinous patches are often located over gaps between convolutions and, when small, partake of the configuration.

The recesses between convolutions, where an opaque and more or less thickened pia stretches across and levels them with the summits of the gyri, are also the places of predilection of a third type of lesions. These are circumscribed, homogeneous, grayish white, white and yellow, slightly greenish, or yellow masses of thickening of a denser consistency, either deeply or superficially imbedded within the pial thickening, and distinct or very dim according to the thickness of the film covering the lesions. They may be vaguely outlined and assume, in a measure, the form of the pit and be round, triangular, or stellate, 2, 3, and 4 mm. in diameter, or they may be well defined, round, nodular, flat or elevated, miliary and submiliary, very distinct or only clearly seen with the hand lens, more frequently single, but also in groups of two and three. They are found in any locality of the convexity. If the opacity of the pia is not too dense these nodular masses are often seen over a vessel. A homogeneous, dense, white or yellowish white thickening is also frequently found in the form of streaks and bands accompanying the vessels. The favorite locality of these forms is the fossa Sylvii which is often leveled by an opaque thickening; occasionally, larger, circumscribed masses of thickening, identical in color, consistency, and general appearance to the former, are seen as superficial, elevated areas, sometimes with raised crenated borders, irregular in shape and following the course of a fissure. Nodular elevations are arranged bead-like in short chains or in ridges.



Text-Figure 1.—Diagrammatic representation of the base of Brain 48 which in addition to the basilar fibrinous exudate, the lesion generally described in accounts of syphilis of the meninges, showed miliary or slightly larger gummas distributed, as illustrated. Structures not shown were covered by the exudate.

Finally, in a few cases the raised, sessile, rarely pedunculated nodule occurs (Text-Figure 1). With strictly basilar meningitis they are all of the miliary type, very small, in groups, and closely apposed. Under the hand lens, however, they are easily discerned as discrete nodules. They are in patches covering the root of th eolfactory trunk, the optic chiasma, the oculomotorius, and over the interpeduncular space; scattered, singly or in small groups, over the temporal lobes and the cerebellar hemispheres. On one brain the nodules, which are exceedingly numerous and usually rather large, are present on the base in by far the largest number in the left fossa Sylvii, but also scattered in various places of the convexity. They vary in size from 2-4 mm. in diameter, are sometimes flat, with raised borders and as if stuck on, often with broad bases and conical, or clubbed, or other irregularly shaped summits. In the left fossa Sylvii they are so close together that they form dense aggregations, while upwards and downwards from the Sylvian fissure, stray nodules are found. The dura is adherent in this locality. On its inner surface there are several patches of closely apposed, or even fused, nodules.

Vascular changes at the base of the brain are not infrequent. The middle cerebral, the basillar, the posterior cerebral, and the vertebral arteries show rigidity and scattered yellow patches of thickening in their walls.

As incidental findings may be mentioned pial hemorrhages, which in one case tinged the entire convex surface a vivid red. In two or three cases, there were restricted areas of hemorrhage. Sometimes, a brain has a peculiarly mottled appearance from the simultaneous presence of patches of white fibrous thickening, areas with blood effusion, regions with a transparent clear pia, gray gelatinous patches, white lines bordering the dark engorged vessels, and small yellowish specks here and there shining through a gray, opaque pia.

Rarely, a brain has only one type of meningeal alterations; there may be only an opacity. Generally there are two and not infrequently all of the lesions are present on one brain. The opacity is generally combined with plaques.

On account of the special attention which the "nodular" ("Knötchenförmige") syphilitic meningitis has recently received, a word concerning the size and general appearance of this group of lesions may be added. The value of classifying this form of syphilitic meningitis as a special type rests upon its great resemblance, macroscopically, to tuberculosis and the necessity of differentiating it from the latter. Baumgarten[3] took particular care in his case of syphilitic meningitis, with multiple gummas already mentioned, to separate the larger nodules from suspiciously small ones. The latter were scrupulously searched for, but not found. The larger nodules, ranging in size from a hempseed to a cherrystone, were very numerous. In a subject who had both tuberculosis and syphilis, why were these lesions of the brain diagnosed as syphilitic when the small nodules in the lung were diagnosed without hesitation as tuberculous? Baumgarten's arguments for distinguishing the two are based on the size and appearance of the nodules. In his case, the nodules were nowhere smaller than a hempseed, and this was a point of importance to him.

Of this type in which there is a definite border line for the minimal size of the larger nodule, there is not a single example in our collection. Brain 32, which has numerous nodules with a maximum size of 3 mm., has also a great many smaller nodules, 1 mm. and smaller, both on the convex surface and on the base, some of which are discernible as nodules only with the hand lens. A single minute nodule is sometimes seen in the immediate neighborhood of a large nodule. All these nodules are raised.

Apart from the absence or presence of any microscopical difference, the situation of the nodules above or below the level of the surface constitutes a difference. When raised, they occupy chiefly the free surfaces of the convolutions on the base and other superficial structures, in one case, the olfactory nerve trunk. The non-elevated nodule is situated in the recesses formed by joining convolutions, and in this location it must be differentiated from another circumscribed lesion found there, a mass of thickening, not very well defined, imbedded in the opaque pia, and taking the configuration of the depression in which it lies, as triangular, stellate, or irregularly rounded masses, the processes not infrequently continued as white lines accompanying the vessels. The nodule, on the other hand, is always well defined, even when deeply placed and covered by a turbid film, and the hand lens will always show it as a distinct nodule, even tho two or more nodules are seen in one depression. Also, its form is independent of the shape of the recess. A direct connection between these nodules and the white lines following the vessels is not evident.

If we compare the gross changes with what has been generally described and adopt current terms, we come to these conclusions: Diffuse syphilitic meningitis, the common affection of the meninges, is very rare, and miliary syphilitic meningitis is not so rare as one is led to believe from the literature.

The histological changes we have found are on the whole in accordance with those in the literature. We should, however, remark that general statements, for example, that the diffuse gummatous meningitis at the base is the most frequent form of brain syphilis, can be verified no more by microscopic examination than by an examination of gross appearances. The tendencies of the granulation tissue in meningitis to diffuse spreading and to focalization cannot be strictly separated one from the other, any more than all the syphilitic brain lesions can be appropriately leveled to one group and marked "tertiary" lesions or appropriately divided into "secondary" and "tertiary" lesions. The stages from the extending infiltration to circumscribed round-cell accumulations and the formation of the gumma proper are "flowing" transitions.

Multiplicity and variability are the main characteristics of the pictures in microscopical preparations. All the stages and degrees of acute and chronic and of progressive and healing processes are encountered. The infiltration is slight, considerable, or marked; it is in the arachnoid around the large vessels of the subarachnoid space, in the pia, in the septa, and around the vessels of the cortex it is scattered, diffuse, or shows a tendency to focalization. One, some, or all of these conditions may be present on one brain.

There is a marked tendency of the infiltration to follow the perivascular lymph channels and the adventitial sheaths of the large vessels in the subarachnoid space, the perivascular spaces of the small vessels of the pia and in the cortex to have all degrees of round-cell infiltration. There is however no absolute regularity in this tendency, not even in the same brain. In the same sections it may be observed that some vessels are entirely spared, while those in the immediate neighborhood are surrounded with a dense coat of lymphocytes. Very good examples of such perivascular infiltration may often be found in sections through old necrotic gummatous areas (Figs. 20 and 21); these vessels stand out as concentrically arranged circular or elliptical areas, with the former lumen completely obliterated and now the site of a gumma, and the adventitia transformed into a greatly widened band of chiefly fibrous tissue intermingled with cells. In intermediate stages the cells predominate over the fibrous element in the adventitial layer. The vessels are intimately related to the infiltrating processes and the tendency to focalization is notable. The media is no selective place for infiltration, but scattered cells and small collections of cells are sometimes seen there. The intima also is not a favored site for lymphocytic infiltration; it may be entirely normal. When infiltrated, the round cells are generally scanty and often focalized when the same vessel may have a broad circle of lymphocytes in the adventitial sheath. Occasionally, the veins are the seat of inflammatory processes (Fig. 17), in fact, they may be involved heavily when the arteries are entirely, or almost entirely, spared. The cells in the proliferated portions of the intima of the arteries are of the type which Beitzke describes as different from those in tuberculous thickening of the intima; they are long and stellate cells with oval nuclei.

Giant-cells are not so rarely found; their nuclei are, as a rule, excentrically placed. They are generally in the close vicinity of the elastica interna and rather on the inner side; sometimes they are seen where the elastica is interrupted when they lie half way in the media, half way in the intima. Sometimes, they occupy an area which is bordered by elastic fibers on both sides. The lumina of the vessels are narrowed in various degrees. It is not at all rare to find one large proliferating area projecting from one pole leaving an excentrically placed lumen. A second elastica interna can easily be detected with the aid of special stains, but even the ordinary hematoxylin-eosin stain will sometimes show deeply curved zigzag lines which are not connective tissue. Cholesterol slits and cholesterol giant-cells may be found in the thickening of the intima.

Gummas occur in all sizes. We have studied them in sections cut through a mass projecting from the surface of the brain as a club-shaped nodule, more than 2 mm. in height, through an elevated nodule or ridge, the single nodule being not larger than 1 mm.; through minute nodules, slight elevations under the hand lens, through nodules on a level with the meningeal surface, and have found them in regions where no nodules were seen macroscopically. They represent all stages of formation and degeneration; gummas consisting of only a small, rounded mass of lymphocytes, without epithelioid cells and without any necrotic changes, others with slight, advanced or marked central necrosis with and without giant-cells.

Giant-cells differ in size, general appearance, and situation. Huge giant-cells are seen in a large necrotic gummatous area, not far from a region with a cellulofibrinous exudate; the spindle-shaped nuclei, closely apposed, occupy one-half or less of the peripheral circle. In sections from a fossa Sylvii, the seat of numerous large nodules projecting 2 mm. and more above the surface, the giant-cells present a most varied picture. Many of them are small, but their development through the fusion of epithelioid cells can be well observed. Some have only two or three darkly stained nuclei in one pole of a small area of homogeneous protoplasm, others faint outlines of individual cells and nuclei within the general protoplasmic cell-body. At one place, a rather large elliptical formation with a darker border zone and a more or less homogeneous center might at first sight be taken for a vessel, but in this gummatous area vessels are entirely lacking, while in a neighboring region within the cortex there are numerous vessels filled with blood. Moreover, with the high-power lens the border zone shows the nuclei distinctly. Part of the central area is homogeneous; some of it is occupied by faintly outlined cells or nuclei. In these sections the eosinophils are very numerous.

The fibrous thickening consists in the loosening and multiplication of the fibrous strands (Fig. 10), or in dense, compact masses of connective tissue. The maximum thickness is often opposite a fissure and diminishes as it reaches the summit of the convolution, but it is more generally in the upper portion, i. e., in the arachnoid. Lymphocytes and plasma-cells are found between the bands. The infiltration may however be considerable and rows of blue-stained cells may alternate with red bands of connective tissue (Figs. 11, 12, and 13).

The arachnoid is also frequently the seat of scars (Figs. 4, 6, 7, and 8). These are often lozenge shaped, are opposite the mouth of a sulcus, and vary in size and compactness. Some resemble keloids (Fig. 6) and are composed of rather broad, dense strands of connective tissue with a system of canals between them, recalling in this respect the canaliculization in the pacchionian bodies, from which they are however entirely distinct. The process of healing which the scar represents, may be observed through all stages. In sections through the insula from a case of gummatous meningitis, scar formation is seen in the early stages: a central focus of an inflammatory process, varying in dimensions in the serial sections, is surrounded by broad bands of dense connective tissue. The whole process is limited to the arachnoid (Figs. 10, 11, and 12). In the meshes of the tissue beneath, there is a scattered infiltration which becomes somewhat denser towards the surface of the brain, which in these sections is at a great depth from the outer surface of the meninges. Microscopic preparations from the fossa Sylvii of the same hemisphere are chiefly occupied by gummas (Fig. 9).

Of cells, besides those of the connective-tissue type and their derivatives, the small lymphocytes always predominate. Plasma-cells are very frequently encountered, but always in restricted numbers, and they are always scattered. Eosinophils are present and are occasionally numerous, but polymorphnuclear leukocytes are rare and never numerous. Large and numerous phagocytic cells are met with occasionally, and in one instance of gummatous meningitis they were numerous in sections where there were no gummas. The huge cells, either in large aggregations or scattered, occupy the rather large spaces of the pia and arachnoid where also small groups of lymphocytes are found. The nuclei are large and generally multiple, two, three, and four. Small lymphocytes and other cell inclusions are found within them. Cells containing blood pigment are frequently seen. Fibrin is inconstant, and the amount is variable. It occurs as a serofibrinous or a cellulofibrinous exudate, or consists of a meshwork or single fibrinous shreds (Figs. 5 and 18), and we have found it apparently disappearing (Fig. 4).

In several instances, sections cut through what promised to be a focus of an inflammatory process or a fresh exudate, through dense, hemogeneous, white or yellowish white, circumscribed masses in the recesses between convolutions imbedded in an opaque pia showed these to be nothing but thickening of the connective tissue strands of the pia arachnoid with but a slight infiltration, and what looked like a small well-defined nodule within a turbid or gelatinous pia in a sulcus or pit and which had been described as a nodule, or even definitely as a miliary gumma, proved to be only a scar with or without any infiltration. In one of these instances, the notion that there was an inflammatory process somewhere else in the brain was supported by finding a marked infiltration about some of the small vessels in the brain tissue. A piece from one of the fossae Sylvii was thereupon taken where there were no apparent focal lesions, simply an opacity of the pia, and histological examination showed a marked infiltration within the meshes of the pia. In another case, where again a "nodule" proved to be only ordinary fibrous thickening, the infiltration in the pia close to the brain and in the septa was of a character to arouse the suspicion that this case might be one of gummatous meningitis. The region of the fossa Sylvii was explored and microscopic gummas were found. After these experiences, when cutting pieces for microscopical preparations, one was always taken from the precentral convolution near or at the fossa

Sylvii whether or not there was any marked gross involvement of the pia here. Very frequently an infiltration was found.

In still another case in which all the data indicated gummatous meningitis, two discrete lesions of this type, taken from rather widely separated regions, were found to be scars. Gummas were found in sections from near the fossa Sylvii. In preparations from the insula, interesting stages of progressive infiltrative processes in the pia near the cortex with early stages of healing in the arachnoid were seen. The fossa Sylvii seems a lurking place for syphilitic processes, an easily accessible pathway for the infectious invasion.

As we consider the vast circonvolutional surface of the brain, all covered with pia which everywhere has the same rich supply of blood vessels and lymph channels so inducive to the extension of syphilis, we realize that the examination of a few places cannot in any way give a measure of the character or the extent of the involvement. In a few instances, these limited examinations are fair expressions of the general conditions, but more often additional examinations showed the brain in question to be a real mine of surprises. Even if the histological examinations in a large number of these cases were limited, they were possibly sufficient for the purpose of this study and have yielded valuable information in a general way. The fact that some of this information is best expressed negatively does not decrease their value, for example, a distinct nodule is neither always a gumma nor the seat of any active process; again, the external aspect of a brain cannot always be used as an indicator of the degree or type of syphilitic involvement; and gummatous or miliary gummatous meningitis of the convexity should not be diagnosed before the microscope justifies it.

Preparations were made from fourteen brains for the examination for spirochetes. The old Levaditi method and this method with Noguchi's modification were employed, and occasionally the Stern-Flexner method for smears was used. Typical gummas were found in six brains, but spirochetes in only Brains 32 and 48, tho not infrequently the arrangement of granular segments and other appearances were suggestive of the spiral curves of spirochetes. Many sections from lesions regarded as gummas were stained for tubercle bacilli, but none was found. In view of the generally recognized difficulty in demonstrating spirochetes in the central nervous system, even in the more acute lesions, the failure to find them in places where scars exist or are forming is scarcely surprising.

Therefore, absolute proof that syphilis was the cause of these lesions is lacking. Strong evidence, however, was furnished in some cases by positive Wassermann reactions of the cerebrospinal fluid. These tests were made independently by Dr. Moody and Dr. Jackson with similar results in every case. Of the fluids tested for the Wassermann reaction from twenty-three bodies, thirteen were positive; from six the cerebrospinal fluid was positive when examined by the Lange test. Of the ten "negative" reports the results in several were noted as "unsatisfactory." It is possible that the percentage of positive reactions would have been larger if the fluids could always have been obtained in the proper condition, and if larger amounts of fluid had been used; 0.25 c.c. was the usual quantity employed. Ellis and Swift[42] and Hauptmann[46] agree that the use of a large amount of spinal fluid in tests gives entirely different results than a small amount, especially in the earlier cases, and it is only in such comparatively late manifestations as tabes and dementia paralytica that complement fixation is obtained with amounts as small as 0.05 c.c. Ellis and Swift tested eight cases of what they called "secondary syphilitic meningitis," and with 0.5 c.c. all but one were positive, while with 0.1 c.c. only one out of the eight cases was positive. In cerebrospinal syphilis 33 percent were positive with 0.1 c.c. and 94 percent were positive with 0.5 c.c. of spinal fluid. The results of Hauptmann are parallel, for of forty-four cases of cerebrospinal syphilis forty-two were positive with the larger amount and all were negative with the smaller amount. Nonne and Hauptmann[47] state that "it is well known that the blood in cerebrospinal syphilis is negative in 20-30 percent of cases, and the spinal fluid used in amounts of 0.2 c.c. is negative in at least 80 percent."

That a negative Wassermann reaction of the spinal fluid does not exclude syphilis of the central nervous system is also well illustrated by three of our cases: two of them (Cases 32 and 48), marked examples of syphilitic meningitis with gummas microscopically and macroscopically, numerous lesions elsewhere in the body and positive Wassermann reactions with the blood, the third (Case 49) with a good Lange reaction for syphilis, a strong Nonne reaction, a positive Wassermann reaction of the blood, and syphilitic lesions elsewhere in the body. Negative Wassermann reactions with small amounts of cerebrospinal fluid, under these conditions, may perhaps be an indication that these were cases which were not instances of dementia paralytica.

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[46] Deutsch. Ztschr. f. Nervenh., 1914, 52, p. 240.

[47] Neurol. Centrabl., 1912, 31, p. 94.

The reliability of the Wassermann reaction of fluids taken from dead bodies, except when other infections are also present, hardly needs to be discussed, in spite of the statements, for example, by Thibièrge and Weissenbach.[48]

Attention may be called to the report by Moody, Jackson and Le Count[49] dealing exclusively with the value of these tests with fluids removed from dead bodies. It contains statistics of such tests made from reports by a number of other investigators, amounting to a total of 2,163 fluids examined with 655 positive reactions, and a table of 190 fluids from dead bodies examined by the authors, 122, or 64 percent, of which gave positive reactions.

There is an interesting discussion by Jacob[50] of a case in which death followed treatment with salvarsan. On the night before death the fluid gave a distinctly positive reaction which post mortem "continued to develop in a characteristic manner": phase 1 + +, the Lange reaction + + +, the Wassermann reaction +.

In only five cases (Cases 4, 14, 17, 22, and 43) were all anatomical and serological evidences of syphilis lacking, and in none of these were fluids tested for any of the reactions for syphilis. In five other cases without gross anatomic evidence of syphilis, there were indications of disease of the central nervous system. In two cases (Cases 10 and 13), in which the examination was limited to the head, the clinical diagnosis of cerebral syphilis and cerebral hemorrhage and cortical irritation had been made, and histologically gummas were found in the meninges. In the other three instances there were a positive Wassermann reaction of the spinal fluid, a strong Nonne reaction and a positive Lange reaction for syphilis, respectively. In the remaining forty-five cases, lesions were found in the body, which in varying degrees were regarded as syphilitic. These in the order of their frequency are: aortitis, 20 cases; hyperplasia of the spleen, 19; gummas in the liver, 15; gummas in the spleen, 6; gummas in the lung, 3; gummas in the kidney, 2; gummas in the moderator muscle of the right ventricle, 1; scars in the liver or in the capsule of the liver, 5; scars on the leg, 6; scars on the penis, 4; scars in the spleen, 3; scars in the lung, 1; scars on the arm, 1; scars on the scalp, 1; scars on the skin (location not named), 1; other skin lesions resembling those of lues, 1; ulcers of the leg, 2; syphilitic lesions of the bones of the skull, 5; syphilitic osteitis of the long bones and the vertebra, 1; saddle nose, 1; necrosis with perforation of the hard palate, 1; amyloid degeneration in the kidney, spleen or liver, 4; condyloma latum of the rectum, 1; ulcerative condyloma of the ileum, 1; ulcers in the small and large intestine, 1; gummatous enteritis, 1; aneurysm of the arch of the aorta, 2. From the gross changes and the positive reactions with the tests of the cerebrospinal fluid and blood, support is given to the view that the changes in the meninges are syphilitic.

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[48] Bull. Soc. de méd. lég. de France, Paris, 1911, 8, p. 224; Ann. d'hyg. pub., 1912, 17, p. 81.

[49] Tr. Chicago Path. Soc., 1914, 9, p. 129.

[50] Ztschr. f. d. ges. Neurol. u. Psych., 1913, 19, p. 188.

The large number of cases within a relatively short time with syphilitic lesions in the meninges seemed at first surprising, yet the number correlates well with clinical and serological observations. In recent years, as we have stated, attention has been repeatedly drawn to the frequency of involvement of the central nervous system in syphilis.

A summary of the histological changes shows that gummas were found in only ten brains (Brains 1, 2, 3, 10, 13, 21, 23, 32, 48, and 55) after a study of relatively few places; with more extensive histological examination they undoubtedly could be found in others. In selecting sections for photomicrographs, an effort has been made to illustrate the gradual transition between gummas in the meninges and the scars which they leave. Such scars resulting from spontaneous healing or healing after specific treatment retain to a considerable degree the location, shape, and general appearance of their antecedent, the gummas, so that in the anatomic diagnoses the expressions "gummatous meningitis" and "syphilitic meningitis" occur repeatedly when the term "syphilitic scar" would be more correct. These small scars have a characteristic gross appearance; they are well-defined nodules or small, opaque regions of thickening in the pits between convolutions, of a triangular stellate, or other polyhedral form, partaking of the configuration of the location. As they occupy most commonly the arachnoid they might appropriately be called "arachnoid scars." They are found frequently associated with other changes more definitely syphilitic, not only on the same brain, but in the same section; they are found in the meninges of brains with typical gummas and arterial changes said to be characteristic of syphilis, they are present on brains without circumscribed gummas, but with marked cellular infiltration in the meninges, and they also are found when active processes are no longer present, and they represent, as discrete patches of fibrous thickening, all that is left in these places in the meninges of a former acute or subacute inflammation.

Wherever post mortem examinations are made by those experienced in such work and also generally in the literature of pathological anatomy, certain stellate scars of the liver are recognized as scars of syphilis as easily as lesions in the skin due to this disease are recognized by an experienced dermatologist.

There are very few scars in the capsule of the liver that in any way simulate these scars of syphilis. Study of the scars and gradually cicatrizing minute masses of granulation tissue in the meninges has impressed us with the idea that these too, as the scars in the capsule of the liver or the lesions of the aorta, termed nodular arteriosclerosis, may serve for the pathological anatomist as definite indications that at one time a syphilis was incurred.

Naturally, one of the most important reasons for ascribing these scars in the meninges to lues is the demonstration of all stages of development between the minute miliary, or even microscopic, focal masses of granulation tissue, with all the essentials histologically of gummas, and such scars, and also their infrequency unassociated with other evidences of syphilis.

Of perhaps more than ordinary interest is the occurrence of sudden or unexpected death in ten of the fifty-five individuals whose brains were studied. The changes in the meninges were inadequate to explain death. The tissue of the brains showed no noteworthy gross changes. From several of these brains pieces were taken from the interior and examined microscopically. The changes were slight, and a detailed study with various special stains was not made. In searching through medicolegal and other literature, no statement was found that leptomeningitis per se may be the cause of sudden death. Weber,[51] in discussing chronic leptomeningitis, without special reference to that resulting from lues, emphasizes the frequency of acute changes elsewhere in the brain and the spinal cord or the meninges of persons whose death is sudden, and the contributory rôle played by hindrance to the drainage of the cerebrospinal fluid.

Since the information regarding some of these sudden deaths in our series is scanty, the question might be raised whether or not these were possibly cases of dementia paralytica. Our histological examination, as far as it has gone, apparently is not in favor of such a supposition; at least, it does not reveal any features pronounced enough to strongly suggest the diagnosis of general paralysis. We naturally would require a somewhat advanced stage of this disease to seriously consider the liability of sudden death from it. There are some interesting statistics about the causes of death in dementia paralytica, outside of that of marasmus, in an article by Roubinovitch and Paillard.[52] The authors distinguish between rapid and sudden death; the former occurring from epileptic and apoplectic attacks. According to Arnaud, this is almost the normal mode of death in progressive paralysis. He found that of forty-three paralytics, thirty-four, or 80 percent, died from this cause, while Delmas found such death in forty-seven of one hundred and fifty-three cases. Sudden death is not entirely exceptional. Arnaud found two deaths of this character in forty-three cases, Maraudou de Montyel found nine in one hundred and four cases, and Delmas four in one hundred and fifty-three cases. From the statistics of these and others, Roubinovitch and Paillard found twenty-five cases of sudden death in five hundred and thirty-eight paralytics, that is 4.6 percent. Sudden death in dementia paralytica occurs chiefly in patients of middle age, in whose previous history there is frequently the record of marked alcoholism. It results from cerebral lesions, most frequently hemorrhage or cardiac disturbances, and without any recognizable cause. Guérin,[53] in a thesis, considered sudden deaths in dementia paralytica. In three no post mortem examinations were made; in three others, the cause was cerebral hemorrhage; in one, death followed catheterization; in one it resulted from a fall; and in the ninth, a chronic alcoholic, death occurred suddenly after a meal. In another series of six the post mortem examinations revealed no noteworthy changes. Roubinovitch and Paillard report one instance of sudden death in the initial stage. They conclude that in the majority of cases sudden death cannot be explained. This conclusion probably also applies to those we encountered. More than one factor is likely to play a part. In addition to the evidence of cerebral syphilis there is the history of alcoholism in several cases. Then, also, it seems utterly futile to attempt to draw definite lines between brain syphilis and the initial stages of changes regarded as characteristic of dementia paralytica. Border line cases occur not only clinically, but also from the viewpoint of pathological anatomy.

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[51] Vrtljsschr. f. gerichtl. Med., 1912, 1, p. 64.

CASE 1.—Man, aged 28 years, became ill rather suddenly with occasional vomiting, headache, and stupor. There were optic neuritis, rigid neck muscles, and a bilateral Babinski reaction. The clinical diagnosis was cerebrospinal syphilis, and the treatment consisted of mercurial inunctions. The initial lesion occurred three years before. The symptoms lasted for about six weeks when death occurred.

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[52] Presse méd., 1909, 17, p. 409.

[53] Quoted by Roubinovitch and Paillard: Presse méd., 1909, 17, p. 409.

Anatomical Diagnosis.—The organs of the trunk were entirely negative except for small scars in the apex of the right lung. An exudate around the optic chiasma and the large vessels led to the diagnosis of syphilitic leptomeningitis (Drs. Kuh and Sceleth).

The pia over the convolutions is thin, but the vessels in all the fissures, except those on the occipital poles, are opaque, dull gray, particularly those of the fossae Sylvii. In three or four places on both hemispheres there is a distinct thickening of the pia in the small triangular pits formed by convolutions. There is a pinkish area, 7 x 15 mm., on the left posterior central convolution, and the pia over this region and over the vessels in the adjoining posterior central fissure is thickened. Under the hand lens the surface is irregular, granular, and slightly elevated. The vessels here stand out as dull, whitish gray, elevated lines. A similar granular appearance of the pia is over the region at the mouth of the right fossa Sylvii. The pia is thickened along the intercerebral fissure, where the very small pacchionian bodies are located. On each frontal pole is an irregular, pinkish-gray plaque of thickening, about 1 cm. in diameter; anteriorly to the plaque on the left side is a round, elevated, warty-looking mass, 3 mm. in diameter, resembling an agglutination of pacchionian bodies. There is a slight depression over the region of the ascending branch of the right fossa Sylvii and the pia-arachnoid here is diffusely thickened and has a granular appearance. On the base is uneven, granular, and rigid thickening of the membrane over the mesial border of the right temporal lobe. The pia over the pons and the anterior part of the medulla oblongata is also somewhat thickened. The vessels are markedly sclerotic. On sectioning the brain two gummas are found. One is in the right insular region in the temporal portion, which is quadrangular in shape, 7 mm. in diameter, approximately 3 mm. deep, and close to it a small hemorrhage, 2 mm. in diameter, is situated in the center of the claustrum. The other gumma, triangular in shape, 4 x 9 mm., is in the left hemisphere mesial to the hippocampal gyrus.

In sections from the left fossa Sylvii is marked involvement of the pia-arachnoid; endarteritic and periarteritic changes are equally pronounced. The proliferated intima of the Sylvian artery is in some portions three times as wide as the media and adventitia together. The smaller arteries, on the other hand, each have an adventitia three and four times as wide as the media and thickened intima. Other vessels are completely obliterated, and the seat of gummas can often be recognized as such only by the more or less concentric arrangement of its layers. The gummas are in various stages of regressive changes. The lymphocytic infiltration is enormous throughout the entire pia-arachnoid, in the septa, and around the small vessels of the cerebral cortex. There is a huge cellulofibrinous exudate in the outer portion of the membrane. Here and there the pia is firmly adherent to the brain. In sections through the left optic nerve is a dense, round-cell infiltration in the pia covering the nerve. The septa, which extend from the pia down between the nerve bundles, are filled with lymphocytes, while the small vessels in the interfascicular spaces are surrounded with cells.

CASE 2.—Man, aged 65, who died three days after admission to the House of Correction Hospital (Dr. Sceleth). No history.

Anatomical Diagnosis.—Gummatous meningitis; syphilitic ulcers of the small and large intestine; multiple gummas of the liver, spleen and kidney; syphilitic osteitis; nodular arteriosclerosis, and edema of the lungs. The ulcers of the intestines were studied by Dr. Arkin who demonstrated the spirocheta pallida in the lesion.[54] There is a marked thickening and edema of the pia over the frontal region (Fig. 1) on both sides. In the sulcus frontalis superior, on the right side about 3 cm. anterior to the sulcus frontalis ascendens, the pia is very much thickened and contains a whitish yellow mass, oblong and of the size of a rice grain. In the left sulcus frontalis superior is a mass of thickening, 0.5 cm. in diameter, and of a yellowish color in the center. In both Sylvian fissures the pia is very much thickened in the form of yellowish streaks. In the region of the ramus ascendens of the left Sylvian fissure there are several small yellowish masses of thickening, each about the size of a pinhead. In the middle part of the fissure of Sylvius there is a patch of hard, yellowish thickening, about 1 cm. in diameter, extending from this region down into the gyrus temporalis superior. The large vessels at the base of the brain seem to be normal with the exception of the bifurcation of the basilar artery where there is considerable thickening. (Description by Dr. Rothstein.)

In preparations from the right superior and the median frontal convolutions there are large "endothelial" cells and small lymphocytes rather loosely scattered in the deeper portions of the arachnoid. The arachnoid is greatly thickened directly opposite the sulci, in some of the sections 8.9 mm. The only other noteworthy change is a thickening of the meningeal veins on the side toward the brain; in one large vein the wall towards the brain is three times as thick as the wall towards the surface. In the sections from the left precentral convolution near the fossa Sylvii is a gumma, 6-8 mm. in diameter. The most necrotic place in this gumma is in direct continuity with the huge fibrinous exudate in the sulcus (Fig. 9). This necrotic region, 2-3 mm. in diameter, is rather sharply demarcated and in a small portion of its margin the nuclei are en pallissade. The brain tissue about this region is not extensively infiltrated with cells, but disarranged with small collections of cells here and there, minute regions of necrosis, some small regions of edema, and some larger regions of hemorrhage. The intima of the Sylvian artery is lifted away from the elastica interna chiefly by an accumulation of fluid in the meshes, formed by widely separated cells with long branching extensions for a distance of 0.2 mm. Close to the channel in this adventitious layer there are many lymphocytes. Phosphotungstic acid hematoxylin stains bring out the fibrin content of this exudate. The whole process is unlike tuberculous meningitis in the scanty number of cells with nuclei, i. e., the very extensive necrosis, in the relative absence of minute microscopic tubercles or focal lesions, and the abscence of giant-cells. In sections from the right insula there is a focal cellular exudate, 1.2 x 1.6 mm. in the very periphery of the arachnoid, and directly beneath it is an oblong necrotic region somewhat larger (Figs. 10 and 11). There are necrotic regions which are not so related to focal cellular exudates; some of them occupy one-fourth of a field 1.8 mm. across. In the deeper parts of the arachnoid and pia there are many lymphocytes rather uniformly distributed. Some of the minute arteries have a greatly swollen and homogeneous adventitia (Fig. 12) and in the deeper parts of the cortex 6-7 mm. from the surface the sheaths of lymphocytes about vessels are wider even than sheaths of those near the surface.

CASE 3.—Woman, 38 years old, at Presbyterian Hospital (Dr. Bassoe), with the complaint of left pelvic pain, nausea and vomiting, backache and leukorrhea. Panhysterectomy. There was a history of headache with nausea and vomiting about once a week, lasting two to three days. She had married at 21 years; there were two miscarriages and it was believed she had been infected by her husband. Improvement followed specific treatment at several intervals. In her last attack, during a thunderstorm, while pressing the call button with the left hand, she thought she was struck by lightning; the left arm was cramped; an hour later she was unconscious with twitching of the left side of the face and arm and involuntary urination. Death two weeks later.

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[54] Tr. Chicago Path. Soc., 1912, 8, p. 224.

Anatomical Diagnosis.—Cerebral syphilis (meningitis); gummatous enteritis; syphilitic scars in the skin; fibrinous and fibrous peritonitis; healed incised wound in the abdomen; hyperplasia of the spleen.

The meninges are very adherent to the calvarium, and the pia and dura have very dense adhesions between them. Along the course of the vessels in the sulci are small patches of thickening. The right hemisphere is one and one-half times larger than the left. There are no gross lesions on the pons, the medulla oblongata, or cerebellum. On the lateral surface of the right hemisphere in the region of the anterior and posterior central convolution above the Sylvian fissure is an irregular gumma, about 5 cm. in diameter, which extends 1-3 cm. into the brain.

A section shows a gumma, 1 mm. long and 6 mm. wide, with the long axis parallel to the surface of the brain. The intimate connection of the gumma with the meningeal changes is clearly seen. From a rounded projection, about 2 mm. in diameter, in the meningeal area the gumma seems to have grown downward and expanded within the brain tissue. Besides this gumma there is no adhesion between the membrane and the cortical surface; the former is easily discernible by a darkly stained, dense infiltration. Microscopic gummas are seen throughout the meninges. The infiltration is marked throughout the pia, in the septa, and around the cortical vessels. There are numerous giant-cells; a few of them are of an unusual size. In another section a smaller gumma, about 3 mm. in diameter, is in the cortex. The meningeal involvement is pronounced. The arterial changes are conspicuous; there is endarteritis with narrowing and complete obliteration of the lumen, thrombus formation, and infiltration of the adventitia. The giant-cells are numerous here.

Case 4.—Man, 31 years old, in Cook County Hospital in a condition of extreme shock from two gunshot wounds of the chest and abdomen; died fifteen minutes after entrance to the hospital.

The wall of the basilar artery is slightly thickened and with a hand lens appears gelatinous. On the convexity of each hemisphere the sulci are deep and broad over the upper half of the motor regions and over the prefrontal region to about the level of the ascending branch of the fossa Sylvii as well as back to the parieto-occipital fissure. Over this region the pia is more or less thickened, most markedly along the marginal borders. On the left side the pia is transformed into a whitish adherent plaque which covers the gyrus along the marginal border from the incisura sulcus corpus callosum to 5 cm. anteriorly. On the right side opposite this plaque, the pia is in a somewhat similar condition, but the changes are not so marked. In the left fossa Sylvii the pia is slightly thickened. In different places on the convexity in the outer margins of the plaques, also in several of the deep sulci, are small gummas. (Description by Dr. Rothstein.)

Sections from the left, superior, frontal convolution show a lozenge-shaped scar in the outer portion of the arachnoid, fairly opposite the mouth of a sulcus. It stains very poorly. In sections from the right precentral fissure the outer limit of the arachnoid is rather far away from the exterior of the brain, on an average 1.25 mm., and the sulcus is correspondingly widened. There is a slight infiltration of the arachnoid with cells; most of the appearances suggest edema. In sections from the left precentral fissure there is a lozenge-shaped scar opposite a sulcus, 1.5-0.5 mm.

CASE 5.—Man, 65 years old, found dead. His son stated that his father had always been in good health, with good hearing and eyesight.

The sulci of the brain are wide and deep, especially over the frontal and parietal lobes and the motor regions. The pia is thickened considerably in these regions, with opacities along the vessels and in places where sulci meet. There are several opaque regions of thickening, pin-point to pin-head in size, located within the pia, and others in the broad sulci of both frontal lobes. They are succulent and of a grayish color. Along the median line, the pia is very much thickened in some places. There are some hemorrhages in the pia of the convexity close to the intercerebral fissure, one in the frontal lobe, one in the motor region, and one anterior to the pre-occipital fissure. There are some yellowish plaques over the basilar artery. In the left internal carotid the lumen is occluded by a grayish brown mass. On the cross-section one is able to make out what seems a thrombus. Small pin-head spots of calcified tissue are seen in the pia along the median line in front. (Description by Dr. Rothstein.)

CASE 6.—Colored man, 39 years old, with tuberculosis and delirium tremens in Cook County Hospital (Dr. Leigh). He had convulsions and vomited and refused food at times. He died three and one-half days after admission.

Anatomical Diagnosis.—General hyperplasia of the lymph glands; gummatous meningitis; nodular and encapsulated tubercles or gummas of the right lung; and marked edema and atrophy of the brain. Fatty liver with slight cirrhosis.

The pia is slightly thickened in the central area along the intercerebral fissure of the frontal and parietal lobes of both hemispheres. Triangular grayish white masses of thickening, 2-3 mm. in diameter, are in many recesses of the sulci of the superior and median frontal convolutions of both hemispheres; they are somewhat more conspicuous on the left side. The pia over the vessels of the fossae Sylvii is turbid and slightly thickened. The pia, passing from one gyrus rectus to the other, appears slightly thickened and turbid. On the median portion of the left temporal lobe there is a mass of warty formations resembling pacchionian bodies.

In sections from the left inferior frontal fissure, the outer limit of the arachnoid is 1-2 mm. away from the surface of the brain, and beneath the arachnoid down to the pia there are mostly only wide spaces. Opposite the mouth of one sulcus there is a slight thickening in the arachnoid. In sections from the left superior frontal fissure there is a large lozenge-shaped necrotic mass of fibrous tissue squarely opposite the opening of a fissure. It is 2 mm. long and nearly 1 mm. wide. The fibers in this scar stain reddish with Mallory's phosphotungstic-acid hematoxylin.

CASE 7.—Man, 42 years old, Cook County Hospital (Dr. Hall). He had been stuporous for six weeks. He had a history of syphilis twelve years ago. There was bloody rectal discharge; the neck slightly rigid; temperature ranged from 100-102 F. from the time of his entrance until his death three days later. Cerebral thrombosis and syphilis of the brain were the final diagnoses.

Anatomical Diagnosis.—Miliary gummas of the meninges; multiple ulcerative condylomas (gummas?) of the ileum; syphilide of the back; hyperplasia of the abdominal lymph glands and the spleen; emaciation; marked edema of the brain, and emphysema of the lungs.

Sections through a nodule show this to consist of a vessel deeply situated and covered with a layer of arachnoid which is considerably thickened and infiltrated with scattered lymphocytes. This thickening of the outer portion of the arachnoid is considerable only in the region opposite a large sulcus. There is a diffuse and rather even infiltration with cells throughout the entire pia-arachnoid and also in the loose meshes of the pial septa. There is none about the vessels in the brain tissue. There are several types of cells; those in the septa and along the vessels are almost exclusively small lymphocytes; those in the arachnoid are plasma-cells and large and small lymphocytes. Cell division is rather frequent. There are no focal accumulations of cells. In sections of other nodules the diffuse cellular infiltration is similar to that just described. The nodule corresponds to a lozenge-shaped area of arachnoid tissue, the loose meshes of which are filled with red blood-cells and all kinds of other cells; many plasma-cells, small and large lymphocytes; cells with two nuclei; and large cells resembling endothelioid cells. Red blood corpuscles are also in large number in the subarachnoid spaces beneath the lozenge-shaped area located opposite a sulcus. The large cells are apparently as numerous as the small cells in these sections.

CASE 8.—Woman, 67 years old, who died in the ambulance. She had been sick for years, "something was the matter with her head," and she also complained of her heart and that she could not get air when she walked.

Post mortem shows marked changes like those of syphilis in the large blood vessels, chiefly in the aorta. The left ventricle is considerably hypertrophied. There are "secondarily contracted kidneys."

There is considerable fluid in the meninges, but the membranes are clear. The convolutions of the brain are generally small, the sulci shallow. The vessels at the base have many areas of thickening. Sections from the base of the brain, in which one-half of the circumference of the internal carotid is included, show marked endarteritic changes in the larger vessels. In one artery the proliferated tissue occupies three-fourths of the lumen. The tissue is, in the main, fibrous and compact, the cellular element relatively scanty; it is separated from the old elastica interna by a crescent-shaped area of lacunar spaces which are infiltrated with scattered lymphocytes. Contiguous to this is a triangular region with the base towards the elastica, which is rather densely infiltrated with small round cells. The fibers of the media of the internal carotid are in one place separated and the meshes loosely infiltrated with round cells. The adventitia in the larger vessels are rather evenly and rather densely infiltrated with lymphocytes. There is no endarteritis in the smaller vessels; the media is thickened; there is only a slight infiltration in the adventitia, when it exists at all; there is none about the small vessels in the brain tissue. The outer portion of the arachnoid is thickened. There is a diffuse infiltration in the entire thickness of the membrane.

CASE 9.—Unknown man, 40-45 years old, found dead. No history.

Anatomical Diagnosis.—Miliary gummas of the liver, spleen and meninges (?); chronic mitral endocarditis; fibrous pericarditis; fibrous pleuritis of the apex of the left lung; healed tuberculosis of the apex of the left lung; passive hyperemia of the liver, spleen, kidney, and gastric mucosa; hyperplasia of the spleen, and catarrhal bronchitis.

The gyri are rounded and protruding, leaving between them in many places depressions forming wide entrances to the sulci, but 0.5-2 mm. below the level of the outer surface of the gyrus the sulci are closed tightly. The pia is very slightly and diffusely thickened along some of the larger veins. Over the frontal pole and over the upper motor region it is still partly succulent. The basilar and cerebral arteries are free from sclerosis. Along the sulcus Sylvii the pia has a soft exudate in it. (Description by Dr. Rothstein.) No histological examination.

CASE 10.—Man brought to Cook County Hospital (Dr. Wells) in a comatose condition; he had been sick for three weeks with severe headache and loss of appetite; for the last two weeks chills, fever. and sweats, and vomiting. There was marked rigidity of the neck, some tenderness in the splenic region, and the Kernig sign and a Babinsky on the right side as well as a lively ankle clonus were obtained. The cerebrospinal fluid (30 drops per minute) gave positive Noguchi on Nonne reactions. The temperature 102 F. Death, four days after entrance. Diagnosis, cerebral meningitis.

Anatomical Diagnosis.—Syphilitic meningitis. (The examination was limited to the cranial cavity and the brain.) The gyri are to a certain extent flattened and the sulci narrowed over all the regions of the brain except the frontal pole. Over the frontal region anterior to the gyri centrales, the sulci are a little wider than at the other parts of the brain. Over the whole convexity of the brain, with exception of the last 3 cm. of the occipital pole and the region above the fissures of Sylvius, the pia is thickened and whitish, especially along the vessels. Along the fissure of Sylvius on both sides the pia is thickened irregularly. Two centimeters lateral from the left sulcus longitudinalis, about 6 cm. anterior to the gyrus centralis, there is an area of thickening of the pia, 0.5 cm. in diameter, with two nodules, about 1 and 2 mm. in diameter. Just anterior to the lower end of the gyrus centralis anterior and about 3 cm. from the fissure of Sylvius is a milky colored nodule smaller than a pin-head. The pia at the base of the brain is only slightly altered, but on the left side between the N. trigeminus and the N. Oculomotorius is a marked thickening and yellowish-white discoloration. The lining of the lateral ventricles over the corpus caudatum is finely granular.

In microscopic preparations from the fossa Sylvii the outer portion of the arachnoid shows an extensive infiltration of large cells and some small lymphocytes. These are scattered along considerable distances, 1 to 3 mm., suggesting later stages of the formation of local fibrous thickening in the arachnoid. There are no marked alterations in the blood-vessels, except for lymphocytic infiltration in the circumference of a large vein, suggestions of definite, minute, focal lesions.

In sections from the left, median, frontal convolution there is a lozenge-shaped scar (Fig. 8) squarely opposite a sulcus 0.3-0.8 mm. in size, its long axis parallel with the surface of the brain; there is no material in this scar that stains, either cells or fibrils. In the sections are also huge collections of lymphocytes and plasma-cells and in those from the right fossa Sylvii is a slight central necrosis in the focal accumulations.

CASE 11.—Man, 43 years old, Cook County Hospital (Dr. Kerr). The abdomen was very rigid; patient appeared in distress and groaned with pain when moved. On the seventh day he passed into a stuporous condition and responded only after repeated stimulation. Symptoms of paralysis were noticed, the right pupil did not react to light, the left not to distance; the right cheek was more wrinkled on smiling; the tongue deviated to the paralyzed side; the abdominal reflexes and the left patellar reflex were absent; the Babinsky sign was present on the left side; there were sensory disturbances on the left side; a Nonne test was negative; the urine was passed involuntarily; the pulse and temperature increased. Cerebrospinal syphilis was diagnosed.

Anatomical Diagnosis.—Syphilitic pachymeningitis and leptomeningitis; disseminated syphilitic caries on the inner surfaces of the cranial bones; subdural hemorrhage from luetic necrosis of the right sinus in the dura; marked compression of the brain; large "plaque jaune" on the under surface of the brain; bronchopneumonia; decubital sacral gangrene; multiple hemorrhages in the pleura and in the gastric mucosa.

The dura is adherent to the bony wall for a distance of 8 cm. over the right temporal region, where it is thickened and of a light yellowish color. On removal of the dura a large semisolid mass, 8 cm. in diameter by 2.5 cm. thick, is found midway in the temporal region and slightly posterior. It is encapsulated by a thin necrotic membrane. The upper and outer surface of the right cerebral hemisphere is concave with the concavity outward covering an area about 10 cm. in diameter, including the fissure of Rolando. The area is somewhat yellowish in color. Over the superior and anterior parts of the hemispheres the meninges are thickened, especially along the sulci, and adherent in the anterior third of the sagittal fissure. A minute "plaque jaune" is present on the under surface of the left temporal lobe. From the anterior surface of the beginning of the foramen magnum is a bony projection pointing backward, 0.75 cm. in height and 1.5 cm. in breadth. Almost the entire posterior fossa presents a granular, worm-eaten appearance. The same condition is present to a less degree in the outer and inferior surface of the middle fossa and to a greater degree in the anterior fossa. The sphenoidal sinus contains a mucopurulent secretion.

Case 12.—Man, 44 years old, Cook County Hospital (Dr. Bassoe). No history, as patient came in unconscious. There were severe convulsions, occurring every two to five minutes and lasting about thirty seconds, involving all the voluntary muscles; during the convulsion the respiration was almost suspended, causing cyanosis. The pupils were unequal and did not react to light. The patellar reflex was slightly exaggerated; the abdominal and cremasteric reflexes were absent; there was no Babinsky. Cerebrospinal syphilis was diagnosed. The patient died the following day.

Anatomical Diagnosis.—Chronic syphilitic meningitis; bronchopneumonia of the right lower lobe (single region); edema of the meninges over the frontal regions; syphilitic periostitis of the inner table of the calvarium with adhesions between the dura and the bone; syphilitic aortitis; sclerosis of the coronary arteries; chronic hyperplasia of the spleen; hydropericardium.

The meninges are slightly edematous. The dura is adherent in places to the calvarium. The meninges are turbid over the lateral surfaces of the frontal, the parietal, and the temporal lobes. There are whitish regions, irregular in shape, stretched along and just without the meningeal vessels in these places. Their borders are irregular and their long axis, parallel with the vessels, extend for great distances, from the beginning of the Sylvian fissure almost to the longitudinal fissure. There is considerable sclerosis of the basal arteries. The edema of the meninges is most marked over the frontal pole where depressions which are full of a gelatinous material occur. This gelatinous material is held in place by the pia arachnoid.

In sections from the cortex of the left cerebral hemisphere including the posterior central fissure at a point 1 cm. from the fossa Sylvii, there is a marked cellular exudate in the deeper parts of the arachnoid chiefly of small cells.

CASE 13.—Man, 60 years old, Cook County Hospital (Dr. Bassoe). Unconscious; face flushed, pupils equal, eyes looked upward and to left, ptosis of left upper lid, a drooping and drawing back of left angle of mouth, expiratory puffing of left side of the face; the muscles of mastication were strongly contracted; the muscles of the chest showed fibrillar twitching, the right leg a spastic condition, the left leg flaccid paralysis; involuntary bladder and bowel movements. In view of a possible cerebral hemorrhage and cortical irritation, a trephine opening was made in the skull, which revealed no changes other than increased pressure. Death three days later.

There is an opacity over the entire convexity, except the anterior temporal poles, and especially marked over the whole right frontal lobe, where the pia is thickened to form dense opaque plaques over the sulci and rather broad streaks along the vessels. Above the right Sylvian fissure these thickenings have a yellowish tinge. On the right hemisphere there is on the posterior central convolution a flat nodule, 3 mm. in diameter, situated on a mass of opaque thickening. At a short distance from this there is in the Rolandic fissure a group of yellow nodules, each about 1 mm. in diameter; three of these nodules are separate and in a row, a few others fuse to form ridges, about 3 mm. long. There is in addition to this a rounded flat mass, 3 mm. in diameter, with a distinctly raised border on half of its periphery. On the right median frontal convolution near the precentral fissure, there are similar rounded masses, 2-3 mm. in diameter, some with a central depression. In a fissure of the inferior frontal convolution towards the Sylvian fissure there are raised irregular grayish masses, 3-4 mm. in diameter. In a fissure of the anterior central convolution there are two oblong nodules, 2 x 3 mm. Only one nodule can be detected on the left hemisphere near the frontal pole located on a vessel. There is a slight thickening of the arteries at the base of the brain.

In larger arteries (1-2 mm. in diameter) there are no marked alterations; there is no endarteritis in small arteries. About medium-sized veins are triangularly shaped regions with the two longer sides, one against the brain, the other a free surface and the third side against the adventitia. In these the pia is more or less densely infiltrated with cells. There is a perivascular lymphangitis. As the pia stretches across convolutions, the regions beneath are filled with coagulated material. The sections from the right precentral convolution possess a number of unusual features of which the most remarkable perhaps is the presence of many very large cells in an exudate of the pia-arachnoid membranes. They are three to four times the diameter of a lymphocyte; some possess two or more nuclei and many have inclusions. Where they are most numerous they compose two-thirds of the cells present; the remainder are lymphocytes. They are very abundant about a small gumma, 1 mm. in diameter near the bottom of the sulcus. Here the large cells form a well-defined zone on the inside of which a narrow layer of lymphocytes encircles the necrotic center. There are no giant-cells. Smaller gummas, approximately 0.2 mm. in diameter, i. e., as large as large human renal glomeruli, are present in the mouth of the precentral sulcus near the Sylvian fissure. There is also a slight gummatous periarteritis about one of the large vessels in these sections and the large outer surface of this forms one border of a huge serofibrinous exudate. The only other noteworthy alteration is a region of thickening of the outer wall of a vein. In microscopic preparations from the right median frontal convolution near the

Sylvian fissure the cellular exudate is almost entirely of lymphocytes. In these sections as well as in those from the precentral convolution, there are narrow sheaths of lymphocytes about the small blood-vessels in the cortex as deep as the sections go — 6-7 mm. In these sections the outer walls of the veins are thickened. Perhaps the most interesting changes are oblong, lozenge- and sector-shaped regions of fibrin in the process of disappearing (Fig. 4). In sections for the pes cerebri the vessels present marked and periarteritic changes. The tendency of the infiltration to be localized is pronounced. The cells are almost all small lymphocytes.

CASE 14.—Died in the ambulance.

Anatomical Diagnosis.— Chronic disseminated syphilitic leptomeningitis; microgyria (occipital); chronic catarrhal gastritis; induration of the lower pole of both epididymides.

On the anterior two-thirds of the convex surface the pia is turbid and thickened. This is most marked on either side of the superior longitudinal fissure for a distance equal to the width of two fingers. There are very definite pits which contain pearly thickenings of the membrane. There is a thickening of the pia about the margin of the cerebellum and in places on the under surface of the brain.

In sections through the right median and left superior frontal convolutions there is a great compact thickening of the arachnoid, which increases from the summit of the convolution towards the sulcus. Opposite the mouth of the sulcus is a scar. There is a great deal of pigment in the entire length of the section in a portion of the membrane beneath the dense outer layer of the arachnoid. The pia is lifted away from the surface of the brain. There is no acute process anywhere. A few scattered lymphocytes and plasma-cells are seen in the arachnoid near vessels.

CASE 15.—Man, hard drinker; died soon after being found on the floor gasping for breath. His general health was apparently good; no history of any disturbance of vision or hearing.

The post mortem showed chronic disseminated leptomeningitis (syphilitic) and slight necrosis of the left parietal bone; hyperplasia of the spleen and of the solitary follicles in the lower ileum.

In the meshes of the pia-arachnoid, especially at the meeting places of the sulci, there are small opaque nodular regions, somewhat thickened and varying in size from a pin-head to 3 mm. These are slightly yellowish and are most marked in the precentral regions of the right and left sides and over the occipital region on the right side. Just anterior to the right and left motor areas and adjacent to the midline, there are two patches of thickening similar to the ones described but larger (about 1 cm. in diameter). There are thirteen or fourteen of these patches. On the surfaces made by sectioning the brain there are no gross changes.

There is an increase in the stroma-like structure of the pia-arachnoid. About the inner half of the entire thickness of the arterial walls is the seat of lime deposition to some degree. In one artery is a clot which possibly is an ante mortem clot. Sections from the interior of the brain, suggested the possible presence of a condition described especially by older writers as "état criblé." There is, indeed, a difference in the appearance of the perivascular spaces of His, the widening of which we are accustomed to contribute to retraction following the process of hardening and fixing. These spaces, in sections from regions below the lateral ventricles and the corpus striatum, are very sharply deliminated towards the brain substance, and frequently strands of tissue (resembling connective tissue with the stain employed), pass from the vessel wall towards the brain surface; in two instances an endothelial lining could be detected. In sections from the left occipital lobe a number of small vessels are occupied, partially or almost entirely, by white cells; some of the polynuclear cells have undergone disintegration.

CASE 16.—Man, found dead.

Anatomical Diagnosis.—Disseminated syphilitic leptomeningitis; edema of the brain (slight); engorgement of the vessels of the pia-arachnoid membranes; gumma in the moderator muscle of the right ventricle; gummas in the liver; syphilitic ulcers of the legs; hyperplasia of the spleen and of the periaortic lymphglands; "saddle-nose"; hypertrophy of the right ventricle with fatty infiltration of the myocardium.

There is an opacity and diffuse thickening of the membrane over the central area of the convexity of the brain. A gelatinous thickening covers the vessels in the two Svlvian fissures. A denser, yellow, triangular thickening is in the horizontal branch of the left Sylvian fissure. There are four gray patches; one in the right median frontal sulcus, one in each Rolandic fissure and the largest one on the frontal pole 1 cm. from the median line.

A slight, scattered cellular exudate is present; the cells are not very numerous. There are no changes about the vessels in the brain substance.

CASE 17.—Man died in great pain enroute to the hospital.

The chief changes in the body, and the only changes which would account for death, were in the brain. All the minute vessels of the pia-arachnoid were greatly engorged with blood. These membranes over the anterior half of the vertex of the cerebrum were cloudy and opaque, with discrete, pearly white, angular regions of thickening in the pit-like meeting points of the sulci of the frontal and parietal lobes. There was also a marked sclerosis of the coronary arteries. The heart muscle was in good condition.

The pia over the anterior half of the cerebrum is thickened. There are round, oval, and stellate patches of a pearly gray color in the sulci or at the junction of sulci. Also, the pia presents a cloudiness in the regions of the sulci. Patches are over the fissure of Rolando, over the posterior central sulcus, and the extreme lateral border of the cerebellum on the right side. On the left side are five patches in the superior frontal sulcus, a small one in the horizontal limb of the Sylvian fissure, and six stellate patches over the posterior central sulcus.

CASE 18.—Unknown man of about 50 years.

Anatomical Diagnosis.—Disseminated fibrous syphilitic leptomeningitis; healed syphilitic necrosis of the hard palate, with perforation. There are three kinds of thickening of the pia-mater. There are stellate thickenings and scars in the parietal regions; the scars are depressed and are usually at the junction of several sulci. The largest scar measures 1 x 0.8 cm. x 1 cm. and is situated 2 cm. from the longitudinal fissure on the left side, in the region of the gyrus centralis. The second type is a membranous thickening most prominent along the longitudinal fissure for a distance of 2-4 cm. The thickest portion of this membrane is 2 mm. The surface of this area is irregular and is studded with pacchionian bodies. The third type is an irregular, whitish thickening of the pia-mater, especially prominent over the frontal gyri and the superior parietal gyri giving a mottled appearance to this region. The pia surrounding the blood-vessels, especially the middle meningeal and the basilar vessels and vessels composing the circle of Willis, is markedly thickened and whitish in color. This thickening extends laterally about 2 or 3 mm. along the course of the vessels. There is a marked sclerosis of the vessels of the base of the brain.

In microscopic preparations from the right precentral convolution where this joins the Rolandic fissure at the intercerebral fissure are irregular patches of thickening in the peripheral or most outer portion of the pia. Some of these stretch along the pia for distances of from 0.8-1.5 mm. and are 0.2-0.4 mm. in thickness. They contain considerable amounts of elastic tissue. These masses are apparently unrelated to the blood-vessels in their location. There are no changes in the minute arteries or about them in the cortex of the brain. In sections from the right median frontal convolution, there are changes of a similar character but less marked. In these patches of fibrous and elastic tissue there is a slight resemblance to keloids.

CASE 19.—Man, 45 years old, Cook County Hospital (Dr. Grinker), with acute alcoholism; died the day after entrance to hospital.

Anatomical Diagnosis.—Lobar pneumonia; marked edema of the brain; fibrous leptomeningitis (syphilitic); supra-arterial, subepicardial fibroid nodules; gummas of the liver and spleen (capsular); vascularization of the diploë (beginning syphilitic ostitis of the diploë).

There is one region of thickening in the brain 1 cm. to the left of the superior longitudinal fissure in the superior frontal sulcus, about 2-3 mm. in diameter. The shape of the convolutions in the frontal poles of the cerebrum is markedly rounded and the sulci are deep, especially in contrast with the remaining portions of the surface of the brain. (Description by Dr. Rothstein.)

In sections from the region of thickening, the most marked change is the presence of cells loosely scattered in the pia which is thickened where it bridges across the sulci. The thickening of the pia consists of an added number of strands, which in this instance lessen the size and increase the number of the spaces between the blood-vessels and the outermost limits of the pia. These strands stain slightly bluish with pinkish margins with phosphotungstic-acid hematoxylin. The region is 0.2 mm. wide and contains seven to eleven of these strands, with narrow spaces between them. The thickening, therefore, is a scar; this is of great interest in view of the gross appearances. In other places the distance between the outer limits of the pia and the outer surface of the brain is just as great, but only three to six strands of fibrous tissue separate the two in some places.

CASE 20.—Man brought to Cook County Hospital in coma. The reflexes normal; a lumbar puncture proved the spinal fluid to be under pressure, 160 drops per minute. Death occurred the next day. The diagnosis was syphilitic meningitis.

Anatomical Diagnosis.—Bilateral bronchopneumonia and fibrous pleuritis; hyperplasia of the spleen, the retroperitoneal lymphglands, and the solitary follicles of the intestines; diffuse syphilitic leptomeningitis; gummas (?) of the liver; petechial hemorrhages in the mucosa of the stomach; fibrous epicardial patches; fibrous adhesions betweeen the liver and the tissues in front of the right kidney.

A milky appearance of the thickened pia is noticeable over the superior two-thirds of the frontal and parietal lobes beside the longitudinal fissure. Over the deep recesses between sulci the infiltration forms triangular and stellate sheets. Pial thickening is also found over the anterior part of the Sylvian fissures and the anterior pole of the temporal lobes. Six nodules, close together (a larger oblong one 3 mm. long, the smaller 1 mm. in diameter) are situated on the left anterior frontal lobe, 18 mm. from the longitudinal sinus close over engorged blood-vessels. A smaller oblong irregular nodule, 1 x 2 mm. in diameter, is in the median frontal fissure, about 2.5 cm. from the group just described.

In sections from the right frontal lobe there is a great thickening of the arachnoid which is made up almost entirely of fibrous tissue. The veins have somewhat thickened walls; in some of them the coat has an almost homogeneous appearance. In sections from the right fossa Sylvii the meninges are of a great width. There are scattered throughout them a great many cells, small round cells, plasma-cells some of which have oval nuclei. The cellular element is very pronounced in sections from another region of the Sylvian fossa.

CASE 21.—Man, 47 years old, brought to Cook County Hospital in stupor. Mitral regurgitation was diagnosed. Death eight hours after admission.

Anatomical Diagnosis.—Marked sclerosis of the coronary arteries with calcareous obliteration of the descending branch of the right; fibrous myocarditis; marked fatty degeneration and hypertrophy of the heart; anasarca ascites; bilateral hydrothorax (slight); ancient scar on the penis; ancient syphilitic scars and crusted lesions on both legs; cirrhosis of the liver (syphilitic?); nodular sclerosis of the aorta; gummatous depression in the motor area of the right hemisphere; ancient scar on the anterior surface of the liver; sclerosis of the vessels at the base of the brain; slight atrophy of the brain.

The meshes of the pia-arachnoid are filled with fluid. The sulci are wide and gaping, especially over the vertex. There is a depression in the middle of the right motor region, about 1 cm. across; the pia over this region is thin and movable. There is a rather marked sclerosis of the vessels at the base of the brain.

In sections through the region of thickening in the left median frontal convolution there is a scattered infiltration of lymphocytes and plasma-cells in the pia. There is no fibrin or other evidence of any acute inflammation. In sections through the right fossa Sylvii there is a marked endarteritis, the lumen of the artery being occluded for a large part. There are regions of infiltration in the adventitia. The arachnoid is not thickened to any extent, but lymphocytes and plasma-cells are scattered throughout. The small vessels in the cortex have thickened walls. In preparations from the right anterior central convolution this infiltration is dense and has a distinct tendency to focalize. There is a marked endarteritis and a slight periarteritis of the vessels in the meninges, and a slight infiltration about the vessels in the brain tissue.

CASE 22.—Man, Cook County Hospital (Dr. Harpole). One week before entrance he had had an attack of illness with unconsciousness, fever, and chill, since that time he could not talk, was helpless and had to be fed. The spinal fluid gave a negative Noguchi reaction. Death in five days. Diagnosis, cerebral meningitis.

Anatomical Diagnosis.—Disseminated fibrous leptomeningitis; engorgement of the vessels of the pia-arachnoid; edema of the brain; catarrhal otitis media. (Examination was limited to the head.) There is considerable fluid in the meshes of the pia-arachnoid over the vertex. The cerebrospinal fluid is clear, colorless, and increased in amount. The minute vessels of the pia-arachnoid are engorged and very tortuous. The vessels at the base of the brain are not markedly altered. In the pia-arachnoid there are numerous disseminated patches of thickening, usually angular in shape, 1-4 mm. in their largest dimensions, and located in the pits formed by the meeting points of sulci in the vertex, parietal and frontal lobes. There are no such changes on the base of the brain.

In sections through the plaque on the right superior frontal convolution joining the precentral convolution, there is a very dense scar-like tissue in the arachnoid, measuring 3.3 mm. in thickness. The pia is densely thickened with a similar tissue. This is especially true in sections taken from the right median frontal convolution. In addition to this fibrous tissue, there is a considerable cell content which is not that of an inflammatory process as ordinarily understood. About one-half of the cells are lymphocytes and the remainder are large cells with cytoplasm which is yellowish brown from pigment or possibly fat (myelin?). In some of the cells, the cytoplasm is very coarsely granular. These cells are found chiefly about the arteries opposite the mouths of sulci. They are numerous enough so that in fields with the immersion lens (0.2 mm. in diameter) there are approximately one hundred, on an average, including both kinds of cells.

CASE 23.—Man, 54 years old, restless and noisy, with scars and bruises on the arms and legs, brought to Cook County Detention Hospital. No previous history.

Anatomical Diagnosis.—Right serofibrinous pleuritis, fibrinous pericarditis; compression atelectasis of the right lung; chronic nephritis ("small granular kidney"); hypertrophy of the heart; stellate scars in the capsule of the liver and spleen.

The cerebrospinal fluid gave a positive Wassermann. There is a slight diffuse thickening of the pia over the anterior three-fourths of the convexity, including the two Sylvian fissures. The sulci and vessels are covered with a grayish film. On the base, the pia is thickened over the optic chiasma and the nerve roots and vessels in the neighboring area.

In sections from the optic chiasm and the right fossa Sylvii, there are large numbers of cells in the pia-arachnoid, and in places these cells are clustered together. In sections from the left precentral convolution, there is a thickening of the outer layer of the arachnoid which in one place, opposite the fissure, is almost transformed into scar tissue. There is an obvious tendency of the cells to focalize. The collections are small. They are especially numerous in that part of the pia which is close to the surface of the brain. A few collections are also in the loose meshes of the inner portion of the arachnoid. The larger vessels in the membrane are normal, but the majority of the small vessels in the cortex are rather evenly and densely infiltrated. In sections from the right side of the pons there is the same tendency to focalized cell grouping.

CASE 24.—Man, 59 years old, admitted to House of Correction in a serious condition. The pulse and the heart action were very feeble, temperature was 2 F. subnormal, and the body was covered with scratches. On the second day the pulse was good and the temperature normal. Ten days later, the temperature again became subnormal, the pulse weak and slow, and the respiration slow. Death on the same day. Diagnosis, alcoholism and carcinoma of the stomach.

Anatomical Diagnosis.—Chronic, disseminated, syphilitic leptomeningitis; gumma of the liver; condyloma latum of the rectum; bronchopneumonia of the right lower lobe; chronic catarrhal bronchitis; edema of the brain; carcinoma of the stomach; chronic diffuse nephritis with secondary atrophy of the kidneys.

On the convexity of the brain the pia has a general gelatinous appearance and is seen as filmy sheets in sulci flattening them out, especially over the upper half of the frontal and parietal lobes, and more markedly over the left hemisphere. Besides this general opacity there are greenish yellow nodular and flat thickenings. On the right hemisphere are two slightly elevated ridges, one 2 mm., the other about 5 mm. long, in the middle portion of the paracentral fissure; a nodular branched ridge, 5-6 mm. long, 1 mm. high, following the course of the vessels in the parieto-occipital fissure, about 15 mm. from the fissura longitudinalis. There is a nodular elevation in its course. This yellowish thickening is continued in the sulcus for 1 cm. as a small nodular ridge and as a triangular, deeply situated area, 2 x 3 mm. On the left hemisphere the focal lesions are: a forked yellowish green linear elevation, the limbs 5 and 6 mm. long, in a deep sulcus of the anterior precentral fissure, about midway between the Sylvian fissure and the sinus longitudinalis, and a narrow ridge, 5 mm. long, running along a slender vessel across the middle third of the posterior part of the median frontal convolution to a sulcus with a heavier nodular branched ridge.

Microscopic sections show that about the beginning of the left middle cerebral artery the pia is considerably thickened. On the side of the vessel towards the brain is a mass of fibrous tissue 0.6 mm. wide, loosely arranged. On the outside of the vessel just under the pia is a thickening that resembles a scar. There are bundles of longitudinal muscle fibers scattered along outside the vessel as accessory layers. There are no signs of either acute or chronic inflammation, unless the changes described are considered part of an inflammatory process. In microscopic preparations from the left anterior central fissure midway between the median line and the fossa Sylvii there is a thickening of the pia which begins on the convolutions, gradually increases and continues across the sulcus. The thickening consists of bands or layers of loose fibrous tissue and the coarseness of the meshwork between them increases towards the brain.

CASE 25.—Unknown man, about 25 years old, found dead.

The spinal fluid gave a positive Wassermann.

The convolutions of the frontal lobe and the anterior and posterior central gyri of both hemispheres are rounded and prominent, and some of the fissures and sulci in these regions are wider and deeper than normal. At the points where the superior and median frontal fissures meet the precentral fissure there are, on both hemispheres, recesses of considerable depth and extent. Those extending from the median frontal fissures each contain a group of pacchionian bodies. On the left side the recess nearer the median line is rendered opaque from a whitish thickening of the pia measuring approximately 1 mm. in depth; white lines accompany the vessels. A recess between the posterior central and the superior and median parietal convolutions is of a similar appearance. On the right side there is a marked opacity and thickening of the pia, about 1.5 cm. long and 4 mm. wide, in the frontal fissure. Along the intercerebral fissure there is a rather uniform thickening of the pia of the posterior part of the superior frontal, central, and anterior portion of the superior parietal convolutions. The pacchionian bodies are coarse. A square white thickening, about 8 mm. wide and possibly 3 mm. deep, is over the left superior frontal convolution. The pia over the frontal lobes is succulent. The right and left middle and posterior cerebral arteries and some of the vessels of the circle of Willis have yellow nodular thickenings.

In sections from the right precentral convolution there is great thickening of the outer portion of the arachnoid which extends as a compact layer over the vault of the convolutions as well as over the fissure; it is thinner towards the summit of the convolution. There are lmyphocytes and plasma-cells scattered loosely throughout the deeper portions of the arachnoid and in the pial septa. There is a great deal of pigment free and some contained within cells in the arachnoid beneath the dense outer layer. The vessels present no changes. In preparations from the left median frontal convolution there is in addition to the changes found in the other sections a lozenge-shaped scar opposite the sulcus.

CASE 26.—Man, 42 years old, Cook County Hospital (Dr. Andrews), with compound fracture of the right leg. Amputation; six days later, death.

The post mortem showed hyperplasia of the spleen; general anemia; syphilitic ulcers of the left leg; nodular syphilitic leptomeningitis; beginning carcinoma of the stomach (gumma?) with hyperplasia of the contiguous lymph nodes; hyperplasia of the retroperitoneal, gastric and periportal lymph nodes.

The changes in the meninges are limited to regions about 13 cm. and 8 cm. broad on each side of the intercerebral fissure and extending forward to the frontal poles of the cerebral hemispheres. There is a milky turbidity of the pia over this entire area and a few thick yellowish plaques, partially covering pacchionian bodies, partially covered by them. The sulci are flattened out by the pial thickening. The vessels are accompanied by linear opacities on both sides.

There are alterations of a chronic nature in the microscopic preparations from the left precentral fissure. The outer portion of the arachnoid, opposite the mouth of this fissure, is thickened for a distance of 2.5 mm. and the center, 1.5-2 mm. of this region of thickening, is necrotic or contains very few nuclei which stain. In this region and also scattered loosely throughout the deeper portion of the arachnoid are many cells, a number of which branch out, with brownish pigment granules inside them.

CASE 27.—Man, shot in a saloon. Wassermann test was negative.

There are small regions of thickening and turbidity of the pia in the meeting points of the sulci over the frontal and parietal lobe. The minute pial vessels are engorged with blood and more tortuous than noraml. There were also syphilitic scars in the capsule of the liver.

CASE 28.—Man, 40 years old, in House of Correction with delirium tremens. Death three days after entrance.

Anatomical Diagnosis.—Disseminative syphilitic cerebral meningitis; traumatic hemorrhage into the left pericranial tissues; myeloid hyperplasia of the diploë; bronchopneumonia; miliary fibrous nodules of the parietal layer of the pericardium.

The spinal fluid gave a positive Wassermann reaction.

In one place in the left frontal lobe where the sulci meet there is a yellowish angular thickening; likewise in the right parietal lobe. In the left cerebral hemisphere, about 2 cm. in front of the interparietal sulcus, there is a greenish gray thickening in the pia 2.5 cm. long and 4.5 mm. wide. There is a marked thickening of the vessels in the pia about the left Sylvian fissure. No histological examination.

CASE 29.—Man, 42 years old, in Cook County Hospital. He was noisy and violent and unable to answer questions. Physical examination was negative. Death on second day after his entrance.

Anatomical Diagnosis.—Fibrous myocarditis; mitral stenosis; microgyria; edema of the brain with engorgement of the vessels of the pia-arachnoid; slight chronic disseminated fibrous leptomeningitis; petechial hemorrhages in the epicardium; marked passive hyperemia of all the viscera; sclerosis of the aorta and coronaries; stellate scars in the capsule of the liver.

The Wassermann reaction of the cerebrospinal fluid was negative.

The minute vessels of the pia are engorged. There are small regions of opacity in the pia over the vertex at the meeting point of the sulci. They are not numerous or large.

In sections from the posterior ramus of the right fossa Sylvii are a few small collections of cells in the deeper portions of the arachnoid in rather definite collections. They are plasma-cells and lymphocytes, rather more of the latter, and among them there are some large endothelial cells. These regions contain brown granules of pigment and in the cytoplasm of some of the large cells there are many fine granules of yellowish green pigment. In the right median frontal convolution is a scar or thickening in the arachnoid, 3 mm. long and 0.5 mm. wide. The larger part of this is necrotic and the necrotic region is lozenge shaped. It is not squarely over the fissure, but a little to one side and the arachnoid here dips down towards the fissure. This region contains many cells which are long, with their axis parallel to the cortex of the brain, with nuclei which do not stain, heavily loaded with pigment granules, some of them so long that they extend one-fourth of the distance of the field of an immersion lens.

CASE 30.—Man, 60 years old, died suddenly. His aunt stated that he had always complained of his brain and had looked as if he had not been in his right mind. His sight had not been very good and he had not been able to hear for twenty years, but understood the motion of the mouth and lips. He had been a hard drinker.

Anatomical Diagnosis.—Disseminated fibrous leptomeningitis; marked edema of the brain; multiple petechiae in parietal pericardium; slight cirrhosis of the liver; slight sclerosis of the coronary arteries.

The blood gave a positive Wassermann reaction.

Where the pia stretches across the base of the brain and covers the anterior perforated space, it adheres in spots, and at the beginning of the Sylvian fissures it is slightly thickened and opaque. Over the vertex it is very thick and gelatinous from the accumulation of fluid. The fissures are wide and distended with fluid. The pia, especially of the sulci, is opaque with angular gray and grayish-yellow opacities which extend as whitish lines on either side of the blood-vessels.

In sections from the junction of the transverse fissure of the right superior frontal convolution with the surface near the intercerebral fissure and in sections from the right anterior central convolution 2 cm. from the midline, the changes consist of a dense but narrow thickening of the outermost part of the arachnoid, a few collections of blood pigment with a scattering of lymphocytes in the deeper parts of the arachnoid and slight increase in the thickness of the outer coats of the small arterioles. The narrow compact thickening in the peripheral part of the arachnoid begins opposite the middle of one convolution and stretches across to a corresponding point on the adjacent convolution, the maximum thickness being close to 180 and located opposite the sulcus, usually near but not opposite the largest of the arteries. This change tapers off to conditions apparently normal near the middle of the convolutions. Sections made from the two fossae Sylvii show similar changes; marked thickening of the arachnoid and a scattered infiltration with lymphocytes and a few plasma cells. The perivascular lymph-space of a vessel situated between the arachnoid and the pia has a distinct endothelial lining on either side.

CASE 31.—An unknown man entered Cook County Hospital (Dr. Morf) in deep coma. No history. Death day after entrance.

Anatomical Diagnosis.—Fracture of base of skull; disseminated fibrous leptomeningitis; syphilis of the aorta with disseminated regions of atrophy; small aneurism of the arch of the aorta; fibrosis of the left lower lobe with multiple minute abscess — unresolved lobar pneumonia (?); old empyema; chronic arthritis of the right sternoclavicular articulation.

The Wassermann test was unsatisfactory.

There are opaque thickenings in the pia-arachnoid over the upper portion of the frontal lobe extending out laterally to the sulci between the first and second frontal convolutions. They are long and narrow and especially marked in the pits between the convolutions.

In sections from the left median frontal convolution there is a marked thickening of the arachnoid, opposite the outer portion of the middle third of the convolution, measuring 4 mm. in maximum extent. On one side, this thickening begins close to the large vessels in the fissure and ceases, as already stated, near the middle of the convolution. In other sections the maximum thickening is located opposite a fissure and the gradual diminution lasts till the next fissure; in other words, it extends clear across the convolution. The thickenings are due to parallel masses of white fibrous tissue forming a felt-like mesh with its greatest density towards the dura and its loosest arrangement towards the pia. In the deeper portions are scattered lymphocytes, a few plasma-cells and other loose cells, which have large amounts of cytoplasm and are phagocytic.

In sections from the interior of the brain in the frontal lobe the changes detected with ordinary stains are an increase in the number of small vessels with complete obliteration of the perivascular space. About many vessels cells are arranged in rows, one and sometimes two. This is especially conspicuous where the capillaries and small vessels are cut in their longitudinal axis. The nuclei of these cells are round, large and rich in chromatin; the cytoplasm is not discernible.

CASE 32.—Man, 29 years old, in Hospital of the House of Correction, with acute alcoholism and dementia. Died in a fit.

Blood from the heart gave a positive Wassermann reaction; the spinal fluid was negative.

Anatomical Diagnosis.—Bolus of meat impacted in the pharynx, occluding the larynx; scar on the penis; gummas of the liver; hyperplasia of tracheobronchial lymphglands and of the solitary lymph follicles of the large bowel; hyperplastic syphilitic meningitis.

On the convexity of the brain the pia is thickened in the form of dull, greenish yellow plaques, overbridging the sulci and plastering them over as with putty. Some of these have poorly defined outlines; others have a distinct borderline, raised and smooth, or finely crenated. Some have smooth, dull, filmlike surfaces, others are glazed.

These plaques are more numerous on the right side. They occupy sulci of the frontal and parietal convolutions and of the Rolandic and Sylvian fissures generally at the location where several fissures converge and where they approximately extend over the peripheral one-third of the corresponding convolutions. They are most conspicuous in the fissures, converging towards the Sylvian fissure. There are also many gummatous nodules of various shapes, sizes, and groupings. One single nodule measures from 2 to 4 mm., with an average of 3 mm. A few are globular, with nearly smooth borders. The majority, however, are flattened, more or less round, irregular in shape and outline, with raised borders, often with an appearance as if stuck on, some with a central depression. A few of these are solitary. In general they form groups. They are located chiefly within and around the left Sylvian fissure. The dura is adherent to the underlying structures just above the Sylvian fissure. Where it can be raised, thick masses of nodules can be seen on the dura and in the fissure. Several clusters of nodules are on the anterior poles of the temporal lobes and two are on the superior frontal convolution of the left hemisphere.

White or yellowish ridges, formed by coalescent nodules and linear elevations in which the nodule fusion is not apparent, are transitional lesions. In the median frontal convolution a chain of densely set, closely apposed, minute nodules follows the windings of a convolution for 2 cm. In the gyrus lingualis, nodules are strung together in a rosary-like formation, 2 cm. long, which appears as if imbedded in the sulcus. Similar groups are seen in the right Rolandic fissure. With the hand lens, vessel-like, greenish yellow lines are seen on both hemispheres not only separately in the sulci and over the plaques, but also running across convolutions. On the basal surface there are plaque-like regions of thickening. There is a slight diffuse infiltrate over the left temporal lobe. Ten round flat nodules, each 2-3 mm. in diameter, are attached to the pia covering the posterior part of the gyri recti. Four irregular nodules are in a group in the anterior portion of the right olfactory fissure. On the left orbital lobe there is an irregular group of about twenty-five flat, raised nodules at the beginning of the Sylvian fissure; the largest one 3-4 mm. in diameter. One cm. from this there is a group of five nodules, averaging 4 mm. each in diameter. On the right temporal lobe, there are three groups, one made up of nine nodules of the flat type with a central depression, each 3-4 mm. in diameter, in a sulcus of the inferior temporal convolution, with nodular extensions toward the pons and in the opposite direction. Another group of eight similar flat nodules is in a fissure of the median temporal convolution, extending towards the group of nodules and masses of nodular infiltrate on the anterior pole of the right temporal lobe that reaches the Sylvian fissure. On the inner surface of the dura mater of the right hemisphere there are seven collections of nodules; the latter measuring 2-3 mm. in height and 3-4 mm. in diameter. On the portion removed from the left hemisphere there are five thick masses of nodules. In some patches the nodules are distinct from one another; in others they are completely fused.

In sections from the right occipitoparietal fissure, 7 cm. from the median line, the sulcus is bridged across in such a way by inflammatory exudate which is largely necrotic and contains small amounts of fibrin that there is practically no indentation to mark its location. Around the margins of this area is a scattered cellular exudate which is rather compact about the small vessels. The cells are chiefly of the lymphocyte type with a very few polymorphous leukocytes and with many large cells of the endothelioid or large lymphocyte variety. The latter are at greater distances from the vessels and frequently contain other leukocytes, red blood corpuscles, or other inclusions. Still another feature of this exudate are the masses of cells which ensheath the minute arteries still deeper in the sulcus, in other words, perivascular changes resembling minute gummas. In the cortex of the brain about the small blood-vessels, which are relatively numerous and relatively large, are also encircling masses of cells from one to three or four cells in width. In sections from the left of the median frontal convolution 5 cm. from the median line, the triangular region formed between the pia and the sides of the convolutions forming the sulcus is occupied by a cellular exudate, most abundant about the arteries. In sections stained with phosphotungstic-acid hematoxylin, these regions are the places where fibrin is most abundant; it forms a loose mesh which has shrunken away from the wall. These regions contain no red blood corpuscles and they have very definite boundaries lined with endothelial cells. In the deeper parts of the sulcus and in the triangular region, there are early perivascular gummas characterized by very minute spots of necrosis in the exudate of cells, some of them 200-300 μ in diameter, with a few multinuclear or giant-cells. There are also numerous regions of necrosis in the cortex of the brain, about 1 mm. below the surface, rarely at deeper levels. The distortion of neuroglia and nuclei of ganglion-cells and the presence of a few lymphocytes are all the alterations in places of this sort where the changes are least. Where the changes are more marked the cell exudate is more abundant. The presence in some of them of a few red blood corpuscles suggests their development in connection with the perivascular accumulations of cells which are present in many places and in varying degrees. Some vessels are filled with cells, and in some cases necrosis of occluded vessels with all or part of the surrounding envelope of cells has taken place. Cross sections of still others contain large numbers of red blood corpuscles, indicating an accumulation of blood as a consequence of a closure somewhere else. Between the vessels, the brain tissue is rather diffusely infiltrated with lymphocytes and plasma-cells, that is, their distribution is fairly equal, and among them are many large cells with cytoplasm equal to from four to ten times the nucleus in area. Masses of brain tissue are found here also. Some of the large cells, so far as the details are revealed by several methods of staining, are ganglion-cells of the cortex. In sections from the right posterior central fissure there are large gummas, 2.5 mm. in their largest diameters, and there are also other regions fully as large of necrosis without enveloping cellular exudates and local changes to mark them as gummas in the usual acceptation of this term. In parts of their circumference these regions, in some instances, show varying amounts of cellular exudate. They also contain small masses of fibrin. One of these gummas is located apparently in a vessel which, following occlusion by thrombosis with partial recanalization of the organized thrombus, has become changed by the process of syphilis so that its former wall represents the margin of the necrosis and in its former channel are the lymphoid multinuclear and other cells found usually surrounding gummas.

In addition to changes that have already been described, there is in microscropic preparations from the left fossa Sylvii towards the anterior temporal pole a region 2.5 mm. where the cortex of the brain possesses a great many newly formed blood-vessels or where the previously existing blood-vessels have become greatly dilated and so infiltrated with cells that it resembles granulation tisue at first glance. Around many of the small vessels are sheaths of cells, chiefly lymphocytes and plasma-cells. In some of the vessels, their channels are completely occupied with these cells, and such vessels with all or part of the surrounding envelope of cells may be necrotic. .Other vessels contain large numbers of red blood corpuscles, indicating an accumulation of blood as a consequence of a closure somewhere else. Between these vessels, with or without cell aggregations, the brain tissue is rather diffusely infiltrated with lymphocytes and plasma-cells, and among them are many large cells with cytoplasm equal to four to ten times the nucleus in area. Some of the large cells are ganglion-cells of the cortex. Masses resembling cells, but without nuclei, are present and undoubtedly represent fragments of brain tissue.

A number of pieces from different regions of the brain surface were prepared by Noguchi's modification of the Levaditi method for spirochetes; also pieces from the dura from gummatous regions were prepared by the old Levaditi method. Only in one instance was it possible to demonstrate spirochetes, which were scanty and scattered within the wall of a vein in a broad sulcus.

CASE 33.—Man, 25 years old, in Cook County Hospital (Dr. Preble). Infected with syphilis and gonorrhea three years ago. The present condition was diagnosed as acute parenchymatous nephritis. Death about a month after admission to hospital.

Anatomical Diagnosis.—Multiple gummas of the liver and lungs; marked amyloid changes in the kidneys, with chronic parenchymatous nephritis; "sago spleen" with multiple infarctions; amyloid liver with marked passive hyperemia and cyanotic atrophy; hydroperitoneum and hydrothorax; chronic local fibrous leptomeningitis; compression atelectasis of the right lower lobe and entire left lung.

The blood gave a strongly positive Wassermann reaction.

There is no noticeable thickening of the meninges on the convexity, except a thin, opaque film over the meeting points of sulci. There is a denser, gelatinous thickening, polyhedral, about 5 mm. in diameter, in a sulcus of the right occipital lobe, 1.5 cm. from the intercerebral fissure. On the base, a slight opaque thickening of the pia is seen as it emerges from the right Sylvian fossa.

In microscopic preparations from the right fossa Sylvii and the right occipital lobe are no noteworthy changes.

CASE 34.—Man, 59 years old, who had suffered from pain in the back, headache, pain in the epigastrium, occasional vomiting and constipation, became suddenly unconscious, then regained consciousness, but was unable to speak for two hours and could not move his left arm or leg. He was delirious the following night and died the next day. There was a history of syphilis and gonorrhea thirty years ago. He had been a heavy drinker for many years.

Anatomical Diagnosis.—Atrophic cirrhosis of the liver; marked ascites; general icterus; chronic diffuse nephritis, secondarily contracted kidneys; fibrous myocarditis; marked edema of the brain; bronchopneumonia of the upper portion of the left lower lobe, sclerosis of the basilar artery with marked narrowing; fibrous (luetic ?) leptomeningitis. The blood gave a strongly positive Wassermann reaction.

There is a grayish, opaque film in the sulci and fissures and along the vessels over the entire convexity. Yellowish white, nodular, rounded regions on the turbid pia are in several places. A flat, oblong, white nodule, 4x2 mm., with slightly raised borders and a depressed center, is on the left superior parietal convolution. Another nodule, 2 mm. in diameter, is on the summit of the left median parietal convolution. In the corresponding locality on the right hemisphere, there is a flat, oblong white nodule, 2x2.5 mm.

In sections from three places, the right and left median frontal and the right median parietal convolutions, the changes are alike, most marked in membranes over the right median frontal. They consist of slight thickening of the arachnoid and of the outer coats of both the larger arteries and veins. In such places, there are small masses of yellowish granules resembling blood pigment, some in cells, some apparently without, none in masses larger than might be contained in phagocytes.

CASE 35.—Man, 53 years old, Cook County Hospital (Dr. Conley). No history. Double lobar pneumonia was diagnosed. Death the day after entrance to hospital.

Anatomical Diagnosis.—Lobar pneumonia of the right upper and middle lobes; hypertrophy of the left ventricle; syphilitic meningitis; arteriosclerosis —syphilitic (?); "plaques jaunes" of the brain; calcified plaques adherent to the skull.

The serum gave a strongly positive Wassermann reaction; the spinal fluid, no reaction.

There is a gelatinous appearance of the pia-arachnoid over the entire convexity. Yellow white thickenings, punctate and of larger size, are found in fissures and recesses between convolutions, especially on the left hemisphere. The most marked alterations of this type are in the median frontal fissure in its posterior part, in the posterior portion of the superior frontal, and in the anterior and posterior central fissures. On the right hemisphere such yellowish thickening is found in a recess of the median frontal convolution and in the posterior central fissure. There is a diffuse grayish thickening over all vessels, especially in the Sylvian and Rolandic fissures. On the base of the brain, the pia over the pedunculi cerebri is turbid and somewhat thickened. The walls of the basilar artery and of the vessels of the circle of Willis are thickened.

In sections from the middle cerebral artery are small regions of thickening in that part of the arachnoid closest to the dura. One of these, taken as a fair example, is 300 μ long and 100 μ wide, the longest dimension parallel to the exterior of the brain. It is located just external to a sulcus, and consists of lymphocytes, rather loosely scattered. Some of the thickenings of this sort contain fewer cells. In another region of this sort is a small obliterated arteriole, and as it diminishes in size in some of the sections of the series, the narrow enveloping zone of lymphocytes makes it resemble a giant-cell. In the pia are many lymphocytes.

CASE 36.—Man, aged 61, with "senility and traumatic arthritis," and later coma and convulsions.

Anatomical Diagnosis.—Gummas of the liver; syphilitic aoritis; beginning aneurism at the junction of the arch and thoracic aorta; syphilitic meningitis (?); marked edema of the brain; turbid cerebrospinal fluid; bronchopneumonia; sclerosis of the coronary arteries; fibrous myocarditis; left ventricular hypertrophy; "plaques jaunes" of the brain.

The spinal fluid gave a positive Wassermann reaction; the serum, no reaction.

There are five "plaques jaunes" on the under surface of the brain. There is a pit just in front of the lower portion of the frontal convolution on the right side, triangular, each side 1.5 cm. in length and with a thickened opaque pia stretched across it. There are similar areas at the junction of the larger sulci, three and four being present on the sides and vertex of each hemisphere. The pia is otherwise transparent. The smaller vessels are uniformly engorged. There is a large amount of turbid cerebrospinal fluid.

In microscopic preparations made from the right superior frontal convolution, the chief change is the presence of scattered lymphocytes in the meshes of the pia. There are a few plasma-cells. The cytoplasm of many of the larger cells is coarsely granular and some of these granules stain with hematoxylin. In others the appearance resembles fine fat globules. At one place near the periphery of a medium-sized artery there is a considerable collection of lymphocytes in the adventitia. The adventitia of some of the arteries is much thickened on the side toward the brain; this is notably so in the left fossa Sylvii, where about one-fourth to one-third of the circumference of a vein, the flattened long diameter of which is 2.2 mm., has a densely constructed tissue reflected over it from the side next the brain, and thick coating, made up of non-striated muscle fiber. In some of the large arteries there is a slight endarteritis.

CASE 37.—Man, 53 years old, Cook County Hospital (Dr. Bloch), in a stupor. The spinal fluid was under considerable pressure; Noguchi test negative. Diagnosis, cerebrospinal syphilis.

Anatomical Diagnosis.—Bronchopneumonia; gummas of the liver, slight syphilitic aortitis; basilar syphilitic meningitis.

The serum was negative; the spinal fluid gave a positive Wassermann reaction.

The brain weighs 1,300 gm. The convolutions of the frontal lobes are very narrow, averaging 0.7 cm. in width, some being only 0.5 to 0.6 cm. On the convexity the pia is generally transparent and without thickening. There are no gross changes in the vessels at the base. Across the anterior perforated space in the triangle formed by the optic tracts and the corpora mammillaria, the pia presents a yellowish gray opacity resembling exudate.

Sections from the involved area at the base are unsatisfactory, because the membrane is badly torn and incomplete. The deeper portion of the pia is thickened, resembling the compact thickening seen frequently in the outer portion of the arachnoid; it is composed almost entirely of fibrous tissue without nuclei, as is shown very distinctly by sections stained with phosphotungstic-acid hematoxylin. There is considerable blood extravasation; in one region the blood-cells are between the pia and the surface of the brain, and in a sulcus they are in all the loose meshes of the pia and around the vessels. Most of the vessels in the brain tissue and some of those in the membrane are engorged with blood; in several places in the nerve tissue blood is poured into the space surrounding the vessels. There is a considerable amount of pigment in the pia. A cellular infiltrate is not present in these incomplete sections. There is marked increase of the neuroglia along the surface.

CASE 38.—Man, age 57, brought to the hospital in a delirious condition. Diagnosis, mitral insufficiency and alcoholism. Death, the following day.

Anatomical Diagnosis.—Syphilis of the meninges; marked edema of the brain; nodular syphilitic sclerosis of the aorta; hypertrophy of the heart; healed and partially calcified thrombo-ulcerative aortic endocarditis; ossification of the falx cerebri; several small brown scars on the right leg.

A Wassermann test of the blood gave no reaction; bile (?) was present; the reaction with the spinal fluid was "unsatisfactory."

Over the entire convexity, except the posterior pole of the occipital lobe, the pia is thickened especially over the central portion along the intercerebral fissure. Beneath the filmy pial covering which passes over the fissures and sulci are diffuse, as well as circumscribed, yellow regions of thickening, appearing as punctate, nodular and larger rounded masses, 2-3 mm. in diameter. They are in the anterior portion of the superior frontal, the median frontal, the anterior and posterior central, and the median parietal fissures of both hemispheres. There are four distinct oblong, raised, yellow nodules, 1 mm. wide, 2-3 mm. long, in the left posterior central fissure, and smaller irregular white nodules along the same fissure and in a transverse fissure towards the Rolandic fissure. There is a thick gelatinous plaque, 1.5 cm. long and 0.5 cm. wide, on the left pole of the frontal lobe and which extends into the intercerebral fissure. Another is on the same hemisphere extending from the anterior to the posterior central fissure and forming a triangle with the base towards the median fissure. There is a plaque with nodular yellow elevations on the right occipital lobe where it joins the parietal lobe. The brain has a peculiar mottled appearance from the gray pial opacity, the yellow thickening, the hemorrhagic areas, and the dilated tortuous vessels. There is a grayish thickening on the basal portion of the left fossa Sylvii. The pia on the base is otherwise unchanged save for a slight turbidity.

In microscopic preparations from the left frontal lobe, the chief change is a thickening of the pia; within it is a great number of small vessels with rather wide outer coats. In between the small vessels, and to a less extent elsewhere, are scattered cells, some of them huge cells with cytoplasm distended with yellowish brown granules and others apparently containing red blood corpuscles. There is a great deal of slightly yellowish brown granular pigment in the thickened pia, not all contained within cells. Most of these large cells or other scattered single cells resemble the clasmatocytes described by Maximow. There are no changes in the adjacent brain tissue, nor in the intima of the arteries. In other sections from the left median frontal convolution, similar alterations are present; loosely constructed thickening in the pia, thickened adventitial coats to small arteries, and the scattered large cells, many of which are loaded with pigment. In sections through the internal carotid and from the fossa Sylvii are endarteritic changes.

CASE 39.—Man, age 49, brought to the Hospital of the House of Correction, with acute alcoholism. Pneumonia developed. Death.

Anatomical Diagnosis.—Hemorrhagic pancreatitis (of some standing); abscess in the lesser peritoneal cavity; old scars on the penis; nodular syphilitic sclerosis of the aorta; old copper-colored scars on the legs, syphilis of the meninges; atrophic cirrhosis of the liver.

The Wassermann reaction of the serum was positive; the spinal fluid was negative.

All the blood vessels are markedly engorged; the sulci are deep. There is a gelatinous, gray thickening of the pia which on both hemispheres extends to the Rolandic fissure, most marked over the frontal lobes and on both hemispheres with about the same intensity. In a recess of the right median frontal fissure is a greenish yellow thickening beneath the gray, pial film. In the central portion beside the intercerebral fissure is a glossy, yellowish white mass of thickening distinct from the extensive plaques formed by the numerous arachnoid villi. There is only slight turbidity of the pia at the base.

In microscopic preparations from the left median frontal convolution near the precentral fissure and from the right anterior central convolution are very few changes, the chief being an edema. In those from the right anterior central convolution there is a slight thickening in the outer portion of the arachnoid. There are no changes in the arteries. In sections from both places there are many cells, partly large cells, partly lymphocytes. In sections through the right median frontal convolution is a lozenge-shaped scar in the arachnoid squarely opposite the sulcus. There are no acute processes in the pia beneath this scar.

CASE 40.—Man brought to Cook County Hospital in deep coma. Morphin poisoning suspected. Death in seven hours.

Anatomical Diagnosis.—Syphilitic leptomeningitis with miliary gummas; copper-colored scar on the leg; pericarditis with effusion.

The spinal fluid gave no reaction.

There is a milky turbidity of the pia over the fissures and sulci which are shallow and narrow. This turbidity is present over the entire convexity except the posterior pole of the occipital lobe, but is most marked over the motor area, where the broadness of the gyri is also a noticeable feature. There is a marked shallowness of the intercerebral fissure, beginning about 1.5 cm. from the anterior frontal pole and extending for 5 cm. The depth of the fissure here is not more than 1 cm. A resilient hardness is felt over this portion. There are distinct lines, about 1 mm. wide, or more diffuse bands, which extend from the fissures to the adjacent convolutions. A somewhat triangular, plaque-like thickening of a whitish yellow color, 7 mm.x10 mm., covers the left Rolandic fissure and the posterior central convolution, 2 cm. from the intercerebral fissure, about 2 mm. thick. Three elevated ridges, 3 mm.x1 mm., extend from this plaque laterally. Another smaller mass of thickening, 2 mm., is on the right precentral convolution, 7 mm. from the intercerebral fissure, covered by smooth, glistening pia. Besides this type of lesion there are solitary nodules; a very distinct yellow nodule, 1 mm. in diameter, is in the right superior fissure 5 cm. from the frontal pole. With the hand lens two other nodules of similar size are seen distinctly near the former, and close to a diffuse infiltration of perhaps 2 mm. thickness. Two other nodular thickenings are in one of the left transverse temporal fissures 1 cm. below the fossa Sylvii. A flat, yellow nodule close to a diffuse mass of thickening is in the left median frontal fissure, 3 cm. from the frontal pole. On the right hemisphere are two nodules, dark yellow, covered with glistening pia, one in the posterior part of the medial frontal fissure, 10 mm. from the intercerebral fissure, the other in the precentral fissure, 3 cm. from the median line.

Microscopic preparations from the posterior part of the right median frontal fissure possess no changes except patches of fibrous thickening of the pia-arachnoid which are most marked at the outer end of the sulcus. There is no endarteritis or any infiltration about the vessels in the brain cortex. In sections from the left posterior central convolution there is a scattered infiltration with lymphocytes and plasma-cells in the sulcus and in the pia along the outer surface of the brain. The arachnoid is evenly thickened and consists chiefly of dense fibrous tissue. Opposite the mouth of the sulcus beneath the large vessels of the subarachnoid space towards the brain is a region of thickening which resembles scar tissue.

CASE 41.—Man, 57 years old, in House of Correction for alcoholism. The right eye was widely divergent. The abdominal, cremasteric, and patellar reflexes were absent. Diagnosis, pneumonia. Death three days after entrance.

Anatomical Diagnosis.—Right serofibrinous pleuritis; lobar pneumonia of the right lung; old scar on the penis; syphilitic meningitis; calcified and caseous tuberculosis of the left apex.

The serum gave no reaction.

The gyri are rather small, the fissures over the frontal and parietal regions wide and deep. The pia has a gray, gelatinous appearance over the convexity; the occipital pole is free. A broad, white band of thickening, 3-5 mm. broad, 5.5 cm. long, 1 mm. thick, on the right hemisphere passes from the intercerebral fissure along the posterior central fissure and the portion of convolution joining it. A narrow band, 3 mm. wide, 2 cm. long, passes obliquely from this band backwards across the convolution and along the fissure behind it. A similar band, less conspicuous, 4 mm. broad, 6 cm. long, passes along the left precentral fissure. Many of the vessels in the fissures are bordered with a whitish line of thickening. Two thick, yellowish white masses, about 2 mm. thick, 3-4 mm. wide, 10 mm. long, are on the left hemisphere in a transverse fissure of the superior frontal convolution. A white, circumscribed mass 2 mm. in diameter, covered by a gray pial film is in the right Rolandic, a similar one is in the right precentral fissure.

In microscopic preparations from the right fossa Sylvii there is a considerable infiltration of lymphocytes; the cells are found in all the layers of the pia-arachnoid. The infiltration is diffuse, but a tendency of the cells to collect in aggregations can be observed. The arachnoid is considerably thickened and the width of the thickening is similar over the vault of the convolutions as over the fissure. The veins have thickened walls. There are no changes in the brain tissue, nor about the cortical vessels. The alterations in sections from the left precentral convolution are similar, except that the infiltration is less marked. In one region of the periphery of the arachnoid is proliferation of the endothelial layer.

CASE 42.—Man, 40 years old, brought to Cook County Hospital wildly delirious, and died next day. Diagnosis, acute alcoholism.

Anatomical Diagnosis.—Marked edema of the brain; gangrenous cystitis, ascending cysto-uretero-pyelo-nephritis; syphilis of the meninges (?).

The spinal fluid gave no reaction to the Wassermann test. There was a positive Nonne and a strongly positive Noguchi butyric acid reaction.

The pia with engorged vessels is slightly thickened over the frontal and parietal regions of the convex surface, somewhat more extensively along the intercerebral fissure over the superior frontal convolution of both hemispheres, but more conspicuously on the left hemisphere, where the vessels in the sulci and fissures, particularly those of the fossa Sylvii, are covered by a whitish gray film. Dense masses of yellowish white thickening are in recesses on both hemispheres. On the left hemisphere a prominent yellow nodule, 2-3 mm. in diameter, is in a recess of the precentral and superior frontal fissures; close to it are two minute nodules, pin-point, on a streak of white infiltrate; 5 mm. more posteriorly there are two flat yellow nodules covered by grayish pia. About the middle of the precentral fissure there is another more indistinct mass of thickening, 2 mm. in diameter. Small nodular, rather indistinct masses, covered by the thickened pia, are also in the superior frontal and the median frontal fissures. Two diffuse white masses, 1 mm. thick, 3-5 mm. wide, are on the superior frontal convolution, 0.5 cm. from the intercerebral fissure, near the pole.

Microscopically, the arachnoid is thickened over the mouth of the sulci. This thickness measures 200 μ here, whereas, over the middle of the convolutions, it becomes very thin, measuring only 12 μ. In sections from the frontal lobe is a lozenge-shaped scar opposite the sulcus.

CASE 43.—Man, 38 years old, in Hospital of House of Correction. He had successions of epileptiform convulsions. Death on day after entrance.

Anatomical Diagnosis.—Bronchopneumonia; chronic diffuse nephritis; turbidity of the pia-arachnoid. Over the anterior and upper half of the two cerebral hemispheres the pia is diffusely turbid, most marked in the sulci. Here the pia stretches across as a cloudy gray, slightly green membrane, but there are no discrete thickenings resembling gummas. No changes in the base of the brain

The chief feature in sections from the right superior frontal fissure is the compactness of the arachnoid thickening in which also the larger vessels in the subarachnoid space are enclosed; there is frequently no space between the wall of the vessels and the tissue of the arachnoid. There is a diffuse, not marked, infiltration with lymphocytes throughout the entire thickness of the membranes. Plasma-cells and large lymphocytes are also present. There are no changes in the brain tissue. In sections from the right parietal lobe and the right fossa Sylvii the changes are similar. There is a marked thickening of the arachnoid, which is very compact over the summit of the convolutions and looser opposite the sulcus. There are scattered in the meshes of the subarachnoid space and the pia cells of various types, chiefly cells with a large amount of cytoplasm and nuclei of an oval, round, or irregular shape, some of them being loaded with a golden yellow pigment; cells with darker stained, round nuclei and little cytoplasms are present, but not in great numbers.

CASE 44.—Man, in Cook County Hospital, died after five days with extensive cancer of face.

Anatomical Diagnosis.—Bronchopneumonia, purulent and gangrenous; extensive carcinoma (rodent ulcer) of the left side of the face; gummatous meningitis; marked syphilitic and senile sclerosis of the aorta; sclerosis of the superior mesenteric and coronary arteries.

Serum and spinal fluid gave no reaction to the Wassermann test.

The pia-arachnoid over the convolutions is not noticeably thickened, but it is opaque over the fissures and many of the vessels in sulci and fissures are lined with streaks of milky white thickening. In the region bordering the intercerebral fissure is a general thickening of the pia on both hemispheres; this is more marked at the vertex of the brain and is more extensive on the left side. The chief change in the membranes consists in well-defined, somewhat raised, grayish white masses of thickening, located in fissures or the meeting-points of sulci. There are two such circumscribed thickenings, each 3 mm. in diameter, on the right hemisphere, one in the superior frontal fissure near the precentral fissure, the other in the posterior central fissure, 2.5 cm. from the median line. Two oblong thickenings, 4 and 5 mm. wide, are in the median frontal and the posterior central fissure, respectively. On the left hemisphere is an oblong thickening, 5 mm. long, 2.5 mm. wide, in the posterior part of the superior frontal fissure; another, 3 mm.x4 mm. in the precentral fissure, 1.5 cm. from the median line; one, 2 mm.x3 mm., in the posterior central fissure, 2 cm. from the median line; and two roundish masses, 3 mm. in diameter, closely apposed, in the median frontal fissure, 1.5 cm. from the precentral fissure.

In microscopic preparations from the right anterior and posterior central convolutions is a long scar in the arachnoid, 4.5 mm. long and 0.9 mm. wide at its widest portion, tapering slightly at the ends and made up of heavy collagenous fibrils as wide as those in the corium of the true skin. These bands are somewhat similar to those in keloids; another similarity to keloids is the presence of narrow channels between the bands lined with endothelial cells, lymph channels, by fibers and channels parallel to the surface of the brain. In the deeper portions of the arachnoid is a scattered cellular exudate, not very abundant. The outer wall of some of the large veins is slightly thickened. In preparations from the right fossa Sylvii there is a scattered infiltration with lymphocytes and some plasma-cells in the lower portions of the membranes. The arachnoid is greatly thickened; this thickening is so dense that it has an almost homogeneous appearance. This is also true of the thickened adventitia of smaller arteries in the cortex. Similar changes are present in sections from the frontal lobe.

CASE 45.—A colored man of middle age, Cook County Hospital, (Dr. Kuh). Diagnosis, cerebral apoplexy. Death on third day after entrance.

Anatomical Diagnosis. — Syphilis of the aorta; thrombosis of the aorta; gummatous meningitis; spontaneous pial hemorrhage; erosion of the brain tissue; acute purulent bronchitis.

The surface of the entire brain is vivid red from a diffuse pial hemorrhage. The fissures on the occipital lobes are marked by broad, black lines, the vessels. Over the central portion of the parietal and frontal lobes a veil-like covering over the entire area gives the vessels in the sulci and fissures a purplish brown appearance. There is a greenish yellow thickening present in all the sulci of the region bordering the intercerebral fissure from the anterior frontal pole to the posterior central fissure, 3 cm. wide. In the left Rolandic fissure, 2.5 cm. from the median line, are two quadrangular masses, 3 mm. in each dimension; an oblong mass, 5 mm. long, over 1 mm. wide, on the summit of which there is a distinct nodule, 2 mm. in diameter; and a triangular mass, 2 mm. on each side. Yellow lines border the vessels in this area. The corresponding area on the opposite side is similar. There are also distinct small nodules, about 1 mm. in diameter, of deep yellow; one such nodule in the right, four on the left hemisphere in the anterior portion of the superior frontal fissure. A yellowish plaque extends along the intercerebral fissure of the left hemisphere from the anterior central convolution to the calloso-marginal fissure, 2 cm. wide. The pacchionian bodies, which are small and very numerous, are over this plaque.

In the microscopic sections from the right superior and median frontal convolutions, the prominent feature is the large amount of blood diffused throughout the meshes and spaces of the subarachnoid space, and assuming the greatest proportions in the region opposite the sulci. The blood effusion does not extend into the septa of the brain surface and is absent or very slight in the deeper portions of the sulci, and there are no changes in or about the vessels in the cortex. The second marked feature in these sections is the thickening of the arachnoid. In those from the superior frontal convolution there is a long, lozenge-shaped scar opposite the slope of the convolution which resembles in every respect that in Figure 6 or 8. In sections from the right median frontal convolution, the thickening involves chiefly the arachnoid proper, but it is also present to some extent in the meshes of the subarachnoid space. In the region opposite each sulcus, the scar-like thickening is focalized and would be lozenge shaped but for the uneven outer surface. There is a comparatively large number of cells in one of these regions of thickening, most of them apparently white cells. In some of the sections the thickening of the subarachnoid tissue is marked and well brought out by the phosphotungstic-acid stain. In a region opposite one of the sulci this thickening recalls the form and structure of the lozenge-shaped scars generally seen in the arachnoid.

CASE 46.—Man, 48 years old. Diagnosis, cerebrospinal syphilis; cerebral hemorrhage.

Anatomical Diagnosis.— Syphilis of the aorta; sclerosis of the coronary arteries of the heart; slight disseminated fibrous leptomeningitis; purulent cystitis; numerous bony excrescences in the lining of the left main bronchus.

The spinal fluid gave a weakly positive Wassermann reaction.

The meningeal vessels are engorged. There is a slight opacity of the entire pia on the convex surface, which is a little more marked over the vessels of the two fossae Sylvii. A whitish thickening is present on both sides along the intercerebral fissure. The pia on the base is also slightly turbid. There are no gross vessel changes.

In preparations from the left precentral convolution there is a localized region of thickening in the pia, 1.0 mm. long and 0.25 mm. wide, a lozenge-shaped scar necrotic in its central two-thirds and with some granules of golden yellow pigment in it, both without and within cells. This scar is not squarely over a sulcus, but is a little on one side. In all the sections examined the sulci are very wide and the arachnoid lifted far away from the brain. There are no changes in the blood-vessels and no cellular exudate.

CASE 47.—Man, 63 years old, unconscious when admitted to Cook County Hospital (Dr. Kuh). No history. There was a coarse nystagmus and the left eye-ball showed internal strabismus; the mouth was drawn to the left; the right cheek was smoothed out; the tongue could not be protruded; there was a spastic condition of both arms with occasional convulsive twitchings of arms, body and legs. The spinal fluid was under pressure; 200 drops per minute. Diagnosis, cerebral lues. Death the next day.

Anatomical Diagnosis.—Scar on the penis; copper-colored scars on the anterior surfaces of the legs; syphilitic aortitis; syphilitic meningitis; gummas of the liver, spleen and kidney.

The serum gave a positive Wassermann reaction, the spinal fluid a weakly positive.

The pial vessels are engorged. There is a marked pial turbidity over the anterior two-thirds of the convex surface extending to and including the fossae Sylvii. The sulci are narrow and shallow. A greenish yellow thickening is seen in fissures and recesses particularly in the region over the superior and median frontal and the central convolutions, on the left hemisphere also in the parietal region extending to the occipital lobe. Under the hand lens these regions of thickening appear as dotted, nodular and rounding, deep, yellow masses covered by a thick, turbid film. The vessels in this entire region are lined by bluish white borders or partially obscured by a white covering. Three triangular plaques, measuring about 10 x 8 mm., are on the right hemisphere along the intercerebral fissure.

In microscopic preparations made from the posterior central convolution 3 cm. from the intercerebral fissure there are no evidences of inflammatory processes. No changes are in the cortex, or in the vessels of the cortex of the brain, or about them.

CASE 48.—Colored man, 31 years old, Cook County Hospital (Dr. Grinker). Diagnosis, cerebrospinal syphilis with disorientation.

Anatomical Diagnosis.—Basilar luetic meningitis; multiple gummas of the liver; multiple small scars of the spleen; emaciation; abscesses of the left wall of the chest and the right seminal vesicle; melanosis of the pia covering the anterior surface of the medulla; healed scars of the left wrist and right forearm.

The Wassermann test was negative with the spinal fluid and weakly positive with the blood from the heart.

The pia arachnoid, which passes from the orbital lobe over the optic chiasma, the anterior perforated space, the tuber cinereum, the corpora mammillaria, over the pons and medulla oblongata, is turbid and greatly thickened, so that all the structures named are obscured, and only the cut ends of nerves and the basilar artery with branches are seen. The thickening is especially marked over the optic chiasma, tuber cinereum, and the corpora mammillaria, and the anterior half of the pons. A collection of numerous small gummas, averaging 1 mm. in diameter, and forming a band 1.5 cm. long and 4 mm. broad, is over the right posterior cerebellar artery. Under the hand lens, about forty flat gummas with central depressions can be counted. A group of seven gummas of similar size are between the right oculo motor nerve and the internal carotid. Nodular elevations are on the right gyri rectus and orbitalis; these and others described in the following text are indicated in Fig. 1; about fourteen are counted; they are 1-2 mm. in diameter; seven are on the right gyrus hippocampi; about twenty faint elevations along the anterior edge of the right cerebellum. About six nodular elevations, 1 mm. in diameter, are dispersed on the left gyri rectus and orbitalis. The sheaths covering the olfactory bulbs are very thick. The basal part of the pia passing over the fossae Sylvii is somewhat thickened. On the convex surface there is only a slight thickening and turbidity along some vessels.

In microscopic preparations made from the region of the corpora mammillaria and of the left oculo-motorius there is less granulation tissue than the gross description indicates. Actual gummas occur in both situations, but the chief change is the presence of an abundance of a fibrino-cellular exudate. This is 2-3 mm. thick in the sections from the corpora mamillaria and nearly as thick from the oculo-motorius region. The gummas are small and located close to the brain tissue. They are flat; in their long dimensions parallel to the surface of the brain, usually just without an arteriole, an average of 0.3-0.6 mm. in their largest dimensions. The gummas possess relatively large proportions of necrosis and the giant-cells, altho not numerous, are very large in many instances. The fibrin fills a region 1-2 mm. wide very loosely, and here and there in its meshes are masses of necrotic cells. When the cells are not necrotic, they seem to be almost entirely lymphocytes and plasma-cells. In places, the fibrin is gathered in curious whorl-like masses with layer after layer wrapped excentrically around the region enclosed. There are very few changes in the adjacent nerve-tissue revealed by the staining methods employed. Close to the brain, the changes about the veins are limited to an infiltration with plasma-cells and lymphocytes; the changes about the arteries, on the other hand, are in general much more marked. The outer coats are loosely or densely infiltrated with cells, much wider than normal. Here, too, are gummas.

With Noguchi's modification of the Levaditi method for spirochetes one organism was demonstrated with absolute certainty. The organism is deeply stained and is just within the outer portion of the cytoplasm of a nerve-cell near the brain surface, outside of which there is a huge fibrino-cellular exudate.

Case 49.—Woman, 48 years old, brought to the Cook County Hospital (Dr. Kuh) in a stuporous condition into which she had fallen the day before. Death the following day.

Anatomical Diagnosis.—Extensive left sided empyema; compression atelectasis of the left lung; nodular sclerosis of the aorta; scar on the anterior surface of the left lung, resembling scars of the liver attributed to lues; miliary gummas of the liver; rupial eruption of the skin; numerous small, copper-colored, depressed scars of the legs; syphilis—gummas—of the meninges; thin skull bones; area of thickened bone in the frontal region of the skull; fibrous adhesions between the dura and the skull; brown atrophy of the heart; absence of the yellow color in the cortex of the adrenals.

The blood gave a positive Wassermann reaction, the spinal fluid gave a negative Wassermann, but a good reaction for syphilis to the Lange and to the Nonne tests.

The brain is small. The anterior and posterior central convolutions of the right hemisphere stand out very prominently; they are more vaulted and the sulci and fissures in this area are deeper and wider than usual. The pia over the convexity, except the occipital lobes, is turbid and generally slightly thickened, markedly over the right central area, anterior and posterior to the Rolandic fissure. There are in addition four circumscribed masses of thickening of a gray and greenish white color under cover of the dull, pial film: one in the precentral fissure about 18 mm. from the intercerebral fissure consisting of two closely apposed nodules with diameters of 2 mm. each; a second one in a sulcus between the anterior central and the median frontal convolution, 2 x 3 mm. in diameter; a smaller nodular mass, 1 mm. in diameter, 5 mm. anterior to this in a transverse fissure; and 1 cm. lateral from this, in the precentral fissure, an oblong nodule, 1 x 2 mm. in diameter. There are no noticeable changes in the pia of the base. The basilar artery has hardened and thickened walls.

Microscopically, the arachnoid is thickened over fissures in the frontal region. Many rather loosely arranged fibers form a thickening here, 1.2 mm. in its maximum dimensions. There are a few lymphocytes and plasma-cells in the deeper portions of the pia. These are not aggregated into clumps, but are widely scattered.

CASE 50.—Man, 40 years old, was brought to the hospital with pneumonia. Death, three days later.

Anatomical Diagnosis.—Lobar pneumonia; chronic thrombo-ulcerative mitral and aortic endocarditis; obliterative pericarditis, syphilis of the meninges; nodular sclerosis of the aorta; bilateral obliterative fibrous pleuritis; slight atrophy of the adrenals; old healed scars on the face and neck.

The blood gave a strongly positive Wassermann reaction.

The precentral fissure on each hemisphere is unusually wide and the vessels running along them are engorged. The fissures of the frontal and central lobes are in general well marked, while those of the parietal and occipital lobes are decidedly narrow and flat. The pia is glistening and not noticeably thickened over the convolutions, but milky and opaque in the fissures and sulci of the anterior two-thirds of the convexity, particularly over the left fossa Sylvii. There is a thickening in the form of a greenish gray streak in a sulcus between the left median frontal and the anterior central convolution. Solitary punctiform thickenings are in the left Sylvian fossa, in the anterior portion of the left median frontal fissure, and in the right posterior central fissure, 4 cm. from the median line. Two plaques, each about 8 mm. in extent and approximately 1 mm. thick, are situated on the superior frontal convolution near the precentral fissure of each hemisphere.

The microscopic changes in sections from the left anterior central fissure are a thickening of the arachnoid, which measures 1.5 mm. in its maximum, and the presence of a few lymphocytes and plasma-cells in the deeper portions of the arachnoid. Usually the lymphocytes and plasma cells are widely scattered. In a few places they are rather closely aggregated about blood-vessels. Similar, but less-marked, changes are in the left Sylvian fossa, that is, changes of a thickening in the arachnoid. The cellular exudate is slightly more abundant here.

CASE 51.—Man, age unknown, brought to hospital in coma, diagnosed as uremic. Died the same day.

Anatomical Diagnosis.—Multiple gummas of the liver and spleen, and old, depressed white scars on the hip.

The spinal fluid gave a positive Wassermann and Lange reactions for syphilis.

The brain, weighing 1,420 gm., is symmetrical in shape, and there are no changes, except for turgescence of the convolutions, narrowing of the sulci, flattening of the exterior of the brain and a little milky opacity of the pia where it stretches across the sulci of the convexity of the frontal lobes. There are no discrete lesions in the pia and the vessels at the base of the brain are unchanged.

There are no noteworthy alterations in the pia-arachnoid in microscopic preparations of the brain cortex made at right angles through the ascending branch of the left Sylvian fissure or through the left Rolandic fissure.

CASE 52.—Man, 75 years old. Cook County Hospital. No history.

Anatomical Diagnosis.—Marked nodular and senile sclerosis of the aorta with atheromatous ulcers; marked sclerosis of the cerebral and coronary arteries; gummas of the meninges; arteriosclerotic atrophy of the kidneys and brain; thrombosis of the left coronary artery; infarction of the myocardium—apex of the left ventricle; myomalacia cords; acute dilatation of the left ventricle—parietal aneurysm; hemorrhagic, purulent, and fibrinous pericarditis; miliary fibroid nodules in the outer layer of the pericardium; "granulation" of the ependymal lining of the ventricle of the brain; opacity in the right crystalline lens.

The spinal fluid gave positive Wassermann and Lange reactions for syphilis.

There is a marked edema of the meshes of the pia arachnoid over the vertex of the brain. The pia is yellowish or slightly opaque in places, but these regions are not numerous, large or sharply outlined, except in the left posterior occipital lobe outwards from the superior longitudinal fissure where there is a pearly yellowish thickening at the bottom of a sulcus at its junction with a shallower one. There is a marked sclerosis of the basilar artery. The pia stretching across the base of the brain is translucent and the middle cerebral artery is thick. The lining of the fourth ventricle is granular.

In sections from the posterior branch of the left fossa Sylvii are no other changes except the endarteritis which produced the whitish patch seen externally. This is a crescent-shaped thickening, from 0.3-0.36 mm. at its widest place and occupying from one-half to two-thirds of the circumference in the various sections examined. The inner part of this patch contains many cells with nuclei, spindle shaped or elongated, which are parallel with the periphery of the channel. The outer part is less regularly arranged, possesses many cholesterin slits with some foreign body giant-cell formation. This patch of endarteritis also contains some fibrin.

CASE 53.—Man, 54 years old, in Cook County Hospital. Diagnosis, cerebral hemorrhage.

Anatomical Diagnosis.—Nodular sclerosis of the aorta; disseminated fibrous (luetic ?) leptomeningitis; spontaneous rupture of a branch of the middle meningeal artery; extensive subdural hemorrhage; marked compression of the left hemisphere.

The spinal fluid gave a weakly positive Wassermann.

The dura is intact on removal of the calvarium and the left half of the dura is collapsed. There are no changes in the superior longitudinal sinus. The left hemisphere is flattened by a clot between the dura and the brain which is spread out over the cortex. There is a large amount of cerebrospinal fluid. The clot is firmly adherent to the inner surface of the dura, but when removed the dura is left smooth. The region of greatest thickness of the clot is over the lower motor areas. The anterior three-fourths of the vertex of the brain are covered by a milky opaque pia. This opaque area is not surrounded by areas of thickening, but there is one such region over the anterior pole of the left hemisphere. In places, especially over the right hemisphere, the vessels are much engorged. There are no changes at the base of the brain. In the vertical portion of the Sylvian fissure the pia is apparently broken and here there is a little, greenish brown, older clot which remains in the sulcus when the brain is removed and when the clot and dura are entirely separated from the brain. There are no changes in the calvarium.

In sections from the left fossa Sylvii the arachnoid is lifted away from the brain for a distance of 2 mm. There is a slight endarteritis and a scanty and uniformly distributed cellular exudate and no other change.

CASE 54.—Man, 19 years old, admitted in coma to Cook County Hospital, and died the following day.

Anatomical Diagnosis.—Syphilitic leptomeningitis and old epicardial hemorrhages.

The blood gave a positive Wassermann and the spinal fluid a positive Lange reaction for syphilis.

Over the vertex of the brain, especially the frontal and parietal lobes, there is a thick, greenish opacity most marked in the sulci. All of the small vessels of the pia are engorged with blood. The cerebrospinal fluid is increased, the brain is wet, and the cortex soft.

The prominent feature in preparations from four regions of the convex surface are the evidences of marked edema, associated with adherence in various places of the inner portion of the membranes to the brain surface. The arachnoid, which is considerably but not uniformly thickened in its outer layer, is lifted far away from the subarachnoid vessels and the pia; the subarachnoid spaces are greatly distended. In sections from the left fossa Sylvii are four lozenge-shaped scars opposite the wide sulcus. Outside of this area the tissue is rich in cells; those of the connective tissue type are apparently in excess to the number of other cells. Similar changes are present in sections from the left Rolandic fissure. There is a great preponderance of the cellular elements over the fibrous tissue. The pia is adherent to the brain surface. There is one lozenge-shaped scar in the arachnoid opposite the sulcus.

CASE 55.—Man, 52 years old, brought to Detention Hospital in a stuporous delirium. Diagnosis, pneumonia with a meningeal complication.

Anatomical Diagnosis.—Lobar pneumonia; chronic ulcerative tuberculosis of the apex of the right lung; caseous nodular tuberculosis of the tracheo-bronchial lymph glands; nodular and miliary tuberculosis of the upper lobes of both lungs; multiple miliary gummas of the brain, liver, and small bowel; gummatous scars of the anterior surface of the liver; syphilitic meningitis.

The spinal fluid gave a positive Wassermann and a positive Lange reaction for syphilis.

On reflecting the temporal muscle and scalp there is a depression in the bone in the anterior temporal fossa, 3 x 2 cm. Beneath the depression in the calvarium there is a region, 0.5 cm. in diameter, where the dura is thickened and yellowish. The brain is not adherent to the dura at this point nor the dura to the calvarium. There is a gelatinous substance which has accumulated in the meshes of the pia-arachnoid. The membranes about the superior longitudinal sinus of the brain are thickened and opaque; also about the fossae Sylvii the pia is not glistening, but is finely granular. On the outside of the hemispheres there are a number of small discrete pin-head-sized gummas in the pia-arachnoid. In the region described as granular, the structures seem to be slightly glued together by an exudate.

In microscopic preparations from the left fossa Sylvii there are numerous gummas in the membranes, mainly in two septa dipping down into the brain substance. There is considerable necrosis in the gummatous tissue. In one of the two sulci the infiltration and the gummatous processes extend from the meninges into the brain tissue. The veins are the chief location for gummas and infiltration; a larger artery in the sub-arachnoid space is practically left intact. The vessels in the brain tissue are without alterations; the infiltration follows the vessels into the cortex and only for a short distance. In some of the sections smaller arteries in the depth of a sulcus are surrounded with a thick coat of tissue rich in cells. The intima is lifted away from the media here and there and the space is filled with small round cells. In only one section a giant-cell is found. Where the gummatous processes in the meninges are marked, the outer portion of the cortex of the adjacent convolutions is frequently involved; there are areas of infiltration of various dimensions, whether the meninges are separated by a space from the brain surface or are closely adherent to it. In microscopic preparations from other portions of the brain, there are similar, but less marked, processes. In some sections from the left frontal lobe there is only a moderate thickening of the arachnoid.

SUMMARY

It is not assumed that the minute scars in the cerebral leptomeninx in all the instances described were caused by syphilis, for other infections may be responsible for them. Nevertheless, we believe that a review of all the evidence presented will convince others, as it has us, that it will be necessary to exclude syphilis before associating these scars with other infections. They bring further evidence of the truly focal character of the lesions of acquired syphilis and should be given a value equal to lesions in other places, as the aorta or liver, in the final summing-up of the evidences for a syphilitic infection obtained by post mortem examination.

Finally, it seems likely that in many instances when syphilis becomes generalized in the human body, perhaps at the time when there is a macular rash, fever, and perhaps a spirochetemia, that among other places where the organisms locate, proliferate, and produce gummas are the membranes of the vertex as well as the base of the brain.

Like the scars and minute gummas in the very periphery of the hepatic circulation just beneath the capsule, which are so common in the liver, these arachnoid scars show that the arachnoid is one of the relatively few places where the organisms find conditions suitable for a limited multiplication after a generalized spirochetemia.

In conclusion, we wish to call attention to the inadequate character of the evidence that alcohol may produce a fibrous leptomeningitis with discrete focal lesions.

EXPLANATION OF PLATES 1-11

PLATE 1

Fig. 1.—Right hemisphere of Brain 2. The pia-arachnoid is of a bluish gray, veil-like turbidity and looks as tho milk had been poured over it and in running off some remained in the deep parts of the sulci. This appearance with the wide sulci and sharply outlined thickenings (a) are the gross changes most commonly encountered.

PLATE 2

Fig. 2.—A drawing of the region of the Sylvian fissure from Brain 32. (a) Cluster of nodular gummas; (b) Chain of minute gummas—gummatous lymphangitis; (c) Plaques of coalescent gummas—"fibrohyperplastic syphilitic meningitis" (Nonne), "Sclero-gummatous meningitis" (Sézary), etc.

PLATE 3

Fig. 3.—The right side of Brain 32, showing coalescent gummas, and plaques resembling paraffin grossly in color and consistency. The lesion is extensive in the lower end of the precentral sulcus (a) spreading out across the beginning of the horizontal limb of the Sylvian fissure.

PLATE 4

Fig. 4.—This lozenge-shaped arachnoid scar, with fibrin in its center (c), is perhaps the lesion most commonly encountered. It stretches squarely across the mouth of the sulcus. (a) Surface of arachnoid; (b) sulcus; (c) region of fibrin; (d) infiltration of lymphocytes about the blood vessels; (e) part of one of the convolutions bounding the sulcus. At other places in this brain a gummatous periarteritis is present (Fig. 5). Brain 13. × 45.

Fig. 5.—Microscopic gumma near the bottom of a sulcus bordering the precentral (right) convolution; phosphotungstic-acid hematoxylin stain. There is a blood vessel (a) in the center of the gumma, a wide zone of fibrin just outside (b), a zone of necrotic tissue with scattered fibrin threads in it (c), and a lightly stained zone of greatly altered, but not necrotic, brain tissue (d). Brain 13. × 19.

PLATE 5

Fig. 6.—Lozenge-shaped scar across the mouth of a sulcus bordering the right precentral convolution. When the scars are old and well cicatrized they resemble keloids, altho sometimes in the region of pacchionian bodies, they are easily differentiated. Brain 4. × 45.

Fig. 7.—Arachnoid scar with gummatous focal accumulation of cells in the sulcus bordering the left median frontal convolution. (a) Lozenge-shaped arachnoid scar with a few cells in it; (b) focal gummatous cellular exudate; (c) infiltration about a vein. Brain 10. × 60.

PLATE 6

Fig. 8.—Arachnoid scar over the mouth of a sulcus limiting the right inferior frontal convolution. After a search in many places gummas were finally found (Fig. 9). Brain 2. × 21.

Fig. 9.—Small gumma in the left precentral convolution near the fossa Sylvii from a section stained with simply hematoxylin and eosin, therefore the fibrin is not black as in Fig. 5. The cellular exudate about the gumma (a) is directly continuous with that in the pia-arachnoid of the sulcus (b); arteria fossae Sylvii (c); marked endo-arteritis and periarteritis. Brain 2. × 8.

PLATE 7

Fig. 10.—Thickened arachnoid with focal lesions over a sulcus in the right insula. At (a) a fresh or recent cellular exudate shown enlarged in Fig. 11; at (b) an arachnoid scar, somewhat necrotic in the center shown enlarged in Fig. 12; at (c) changes about small arterioles and the scattered cellular exudate. All these alterations, it will be noticed, are in the outer part of the arachnoid. Brain 2. × 10.

Fig. 11.—Transitional focal lesion, neither gumma nor scar, shown at (a) in Fig. 12. It resembles a gumma more than any other of the changes. The cells are chiefly small lymphocytes. × 40.

PLATE 8

Fig. 12.—The patches of thickening in the arachnoid which are found so frequently and in the gross examination were termed gummas, were scars, and as the one shown here, often have necrotic centers. Shown at (b) in Fig. 10. × 40.

Fig. 13.—Cellular exudate and changes in the outer walls of small arterioles shown at (c) in Fig. 10. × 40.

PLATE 9

Fig. 14.—Transitional lesion. Focal cellular inflammation about a blood vessel, neither gumma nor scar. Brain 35. × 45.

Fig. 15.—Transitional lesion. Focal inflammation in the arachnoid. Brain 35. × 45.

PLATE 10

Fig. 16.—Chronic changes in the pia about a vein and depressions in the brain in the epicerebral space, possibly from edema. (a) Thickened pia reflected on the vein; (b) perivascular space; (c) epicerebral space. Brain 36. × 45.

Fig. 17.—Focal gummatous cellular exudate (a) in the wall of a vein from the right Sylvian fossa; (b) cellular exudate in the pia-arachnoid meshes. Brain 10. × 60.

PLATE 11

Fig. 18.—Microphotograph of a section from a fibrinopurulent exudate with gummas (Fig. 5). Compare these changes with those about the arterioles in Fig. 13. The section is stained with phosphotungstic-acid hematoxylin, is fibrin black. From the left oculo-motor region. Brain 48. × 90.

Fig. 19.—Gummatous nodular syphilis of the meninges—a rare form of syphilis characterized by a hyperplastic inflammation. Gummas in the occipitoparietal fissure. The gummas occupy the place of blood-vessels. (a) Remains of an artery; (b) portion of the proliferated elastica interna; (c) newly formed vessels in the gumma occupying former arterial lumen. Brain 32. × 25.

PLATE 1

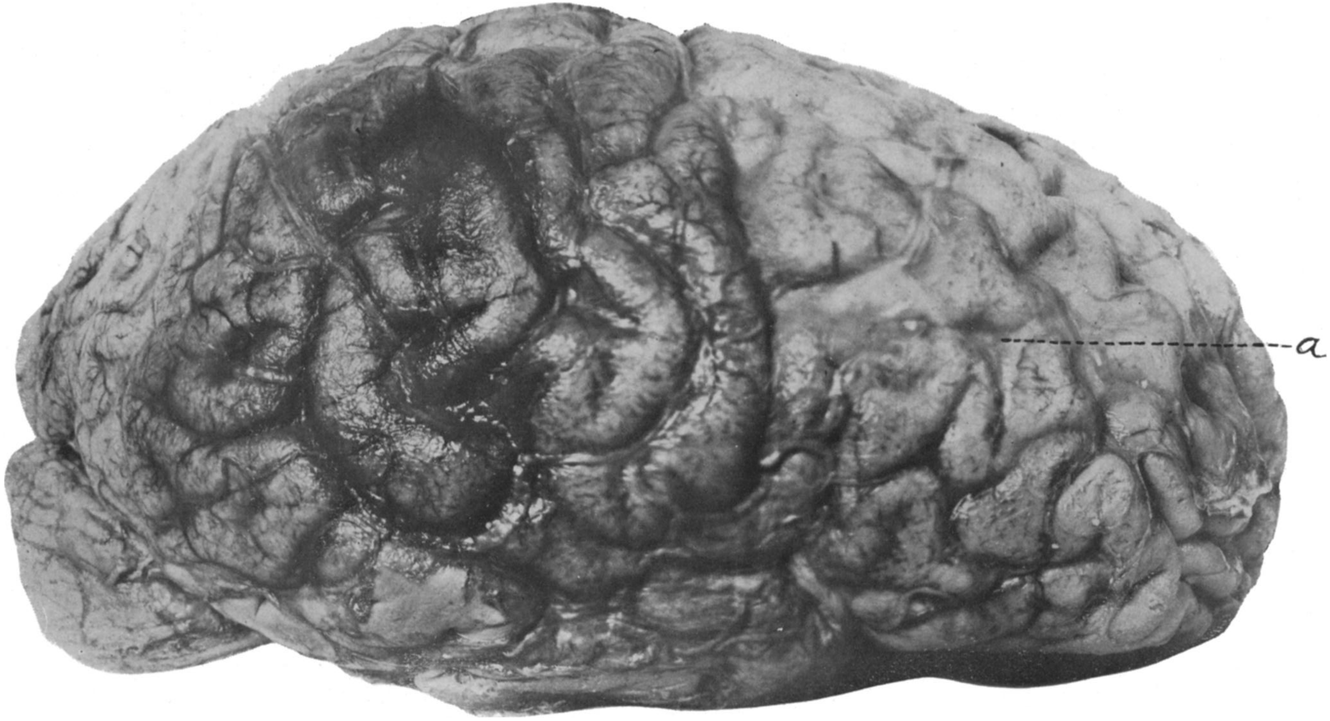


Fig. 1

PLATE 2

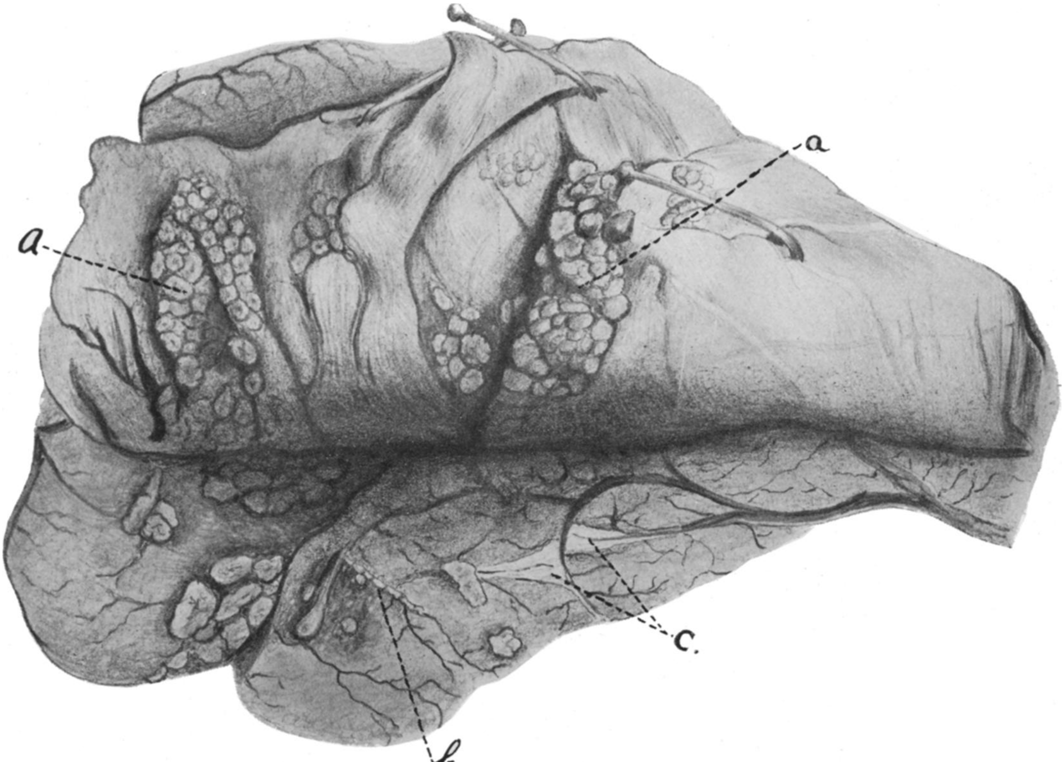


Fig. 2

Plate 3

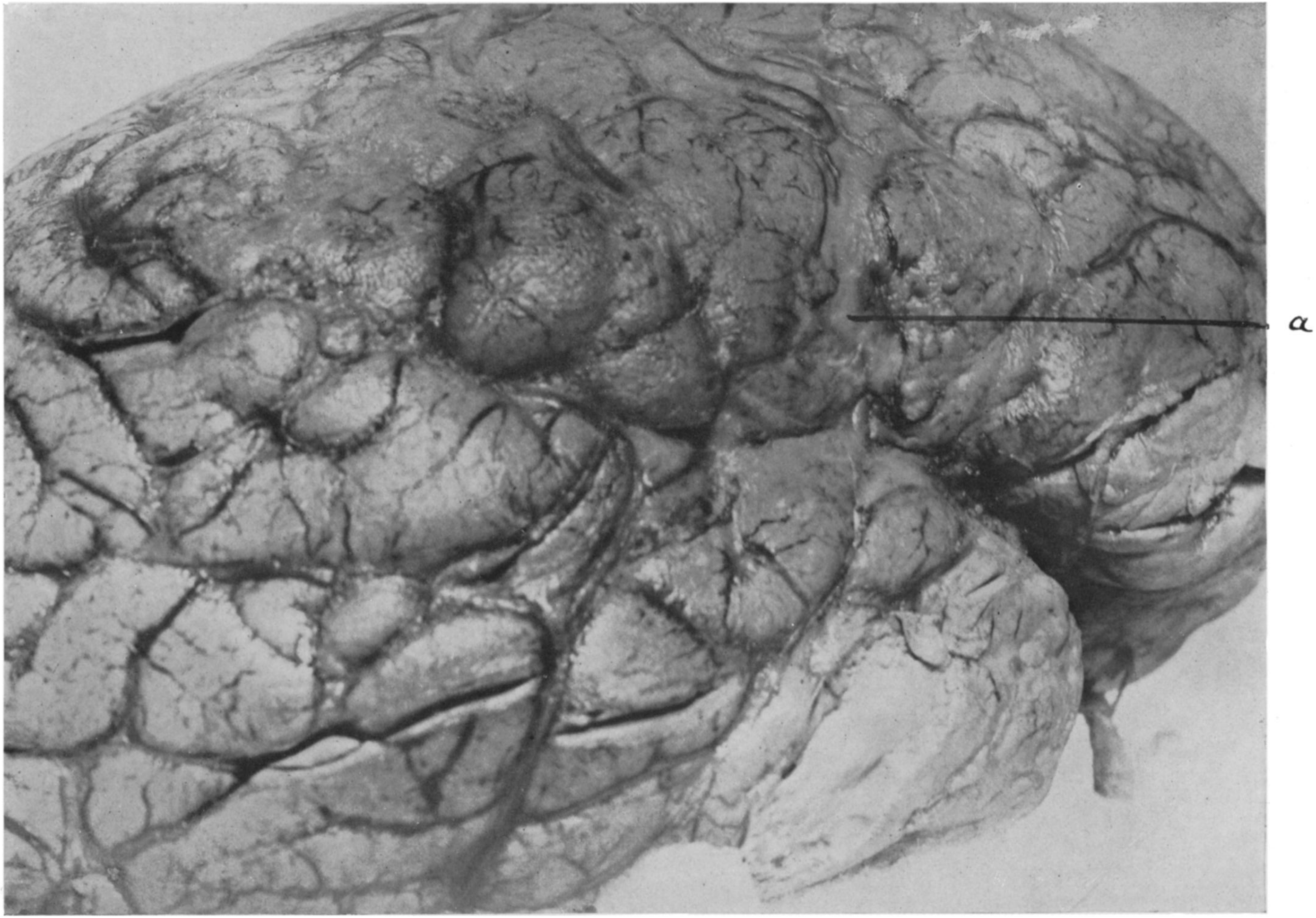
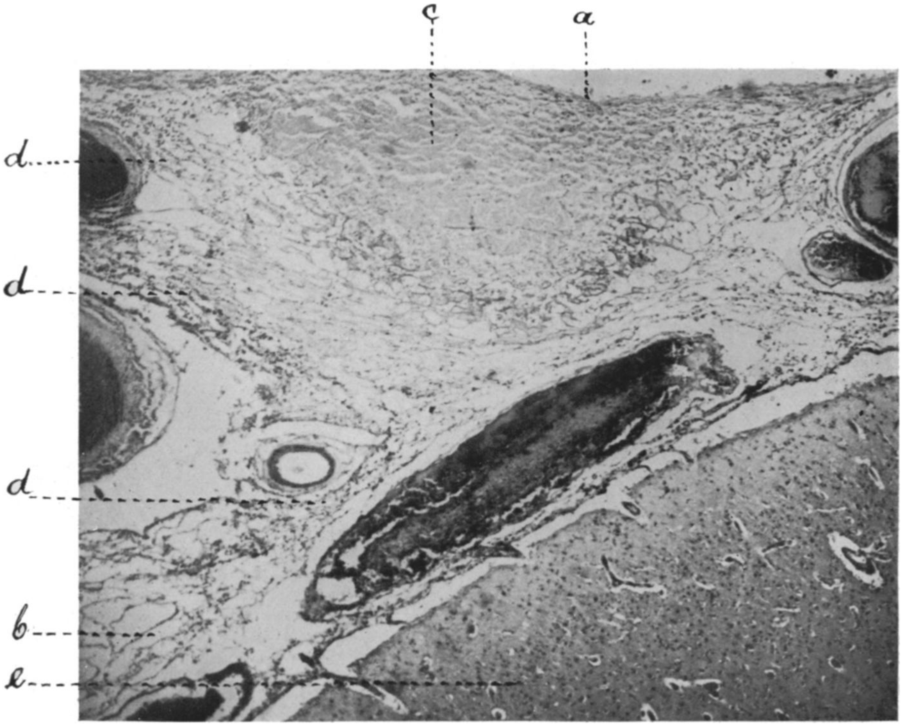


Fig. 3

PLATE 4



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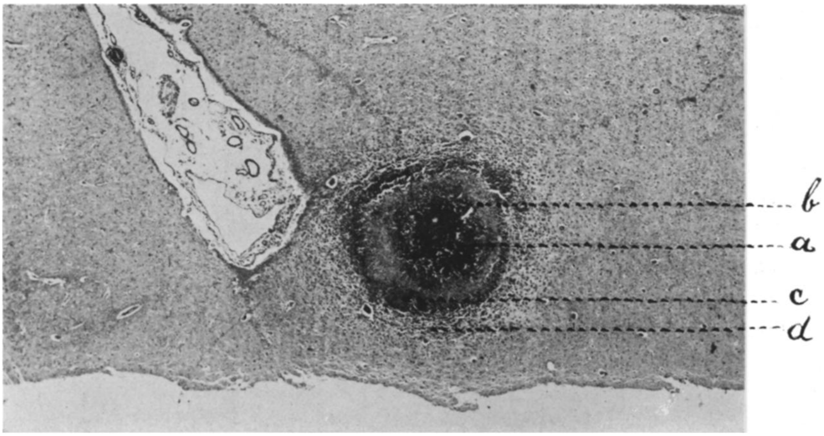


Fig. 5

PLATE 5

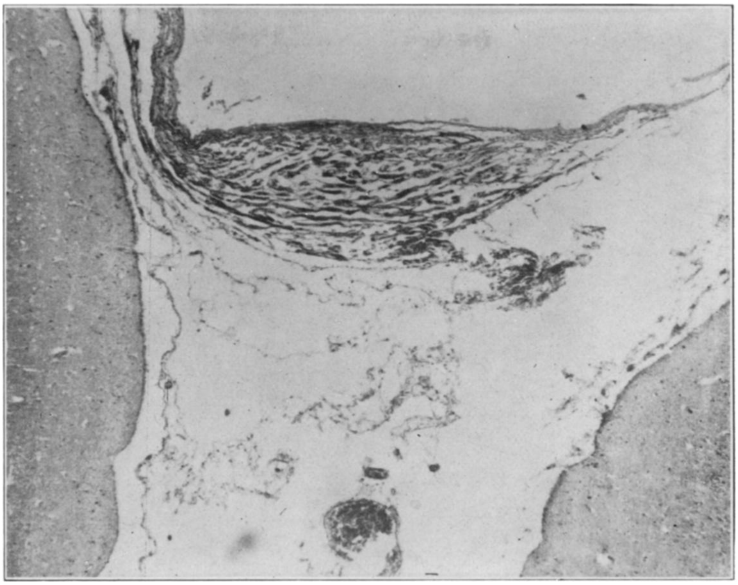


Fig. 6

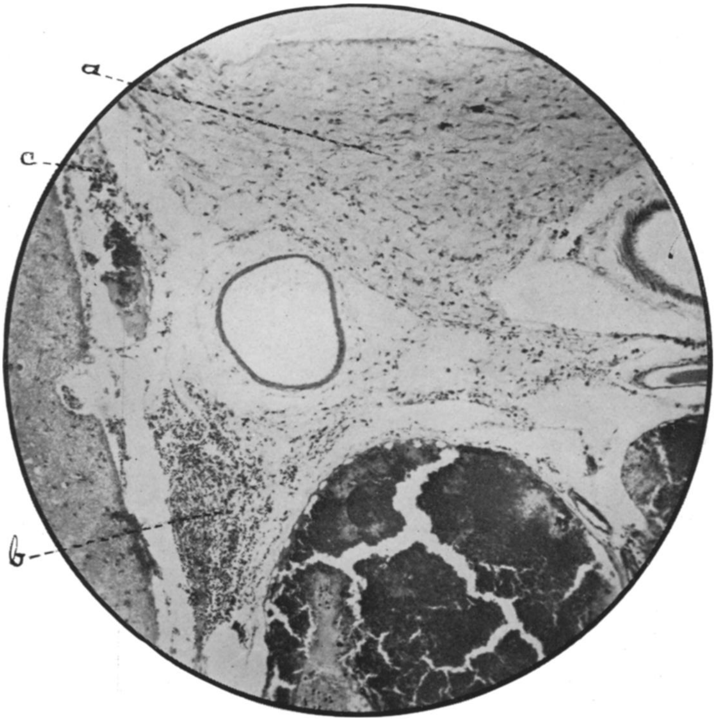


Fig. 7

Plate 6

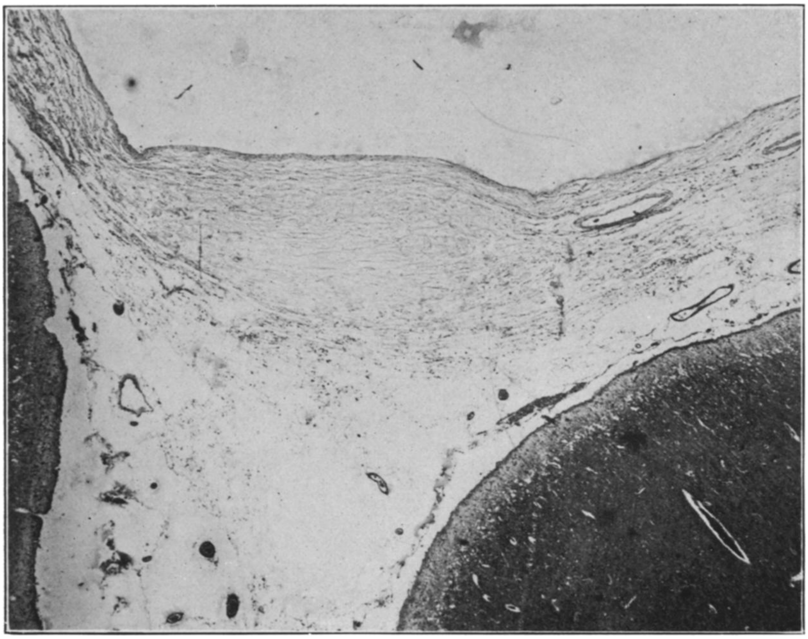


Fig. 8

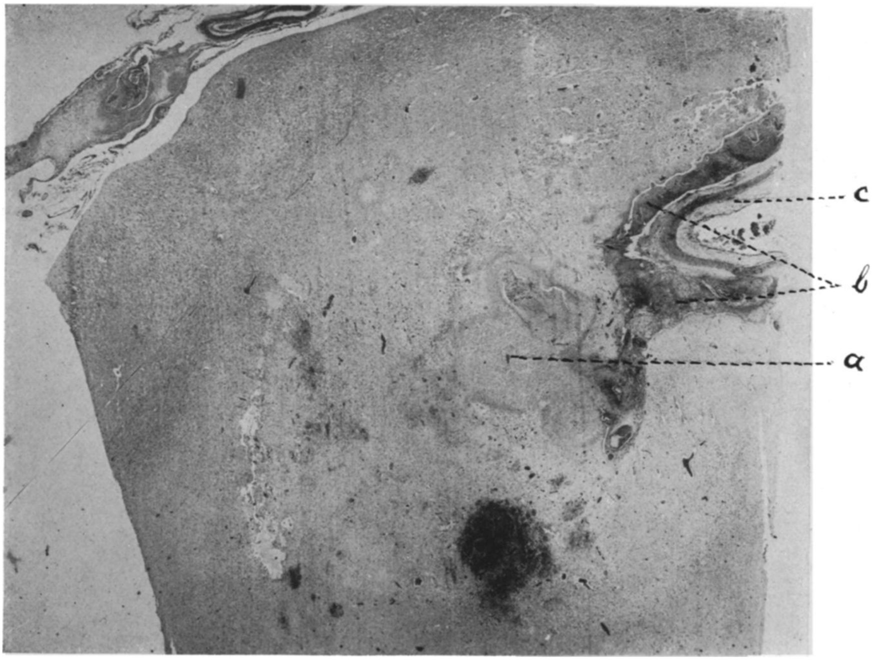


Fig. 9

PLATE 7

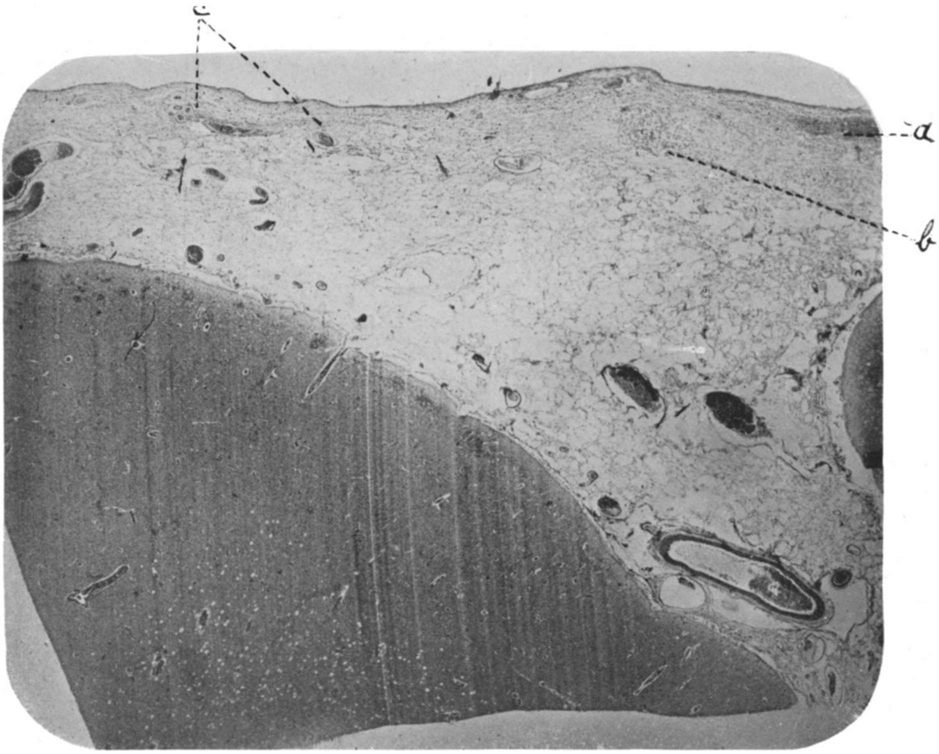


Fig. 10

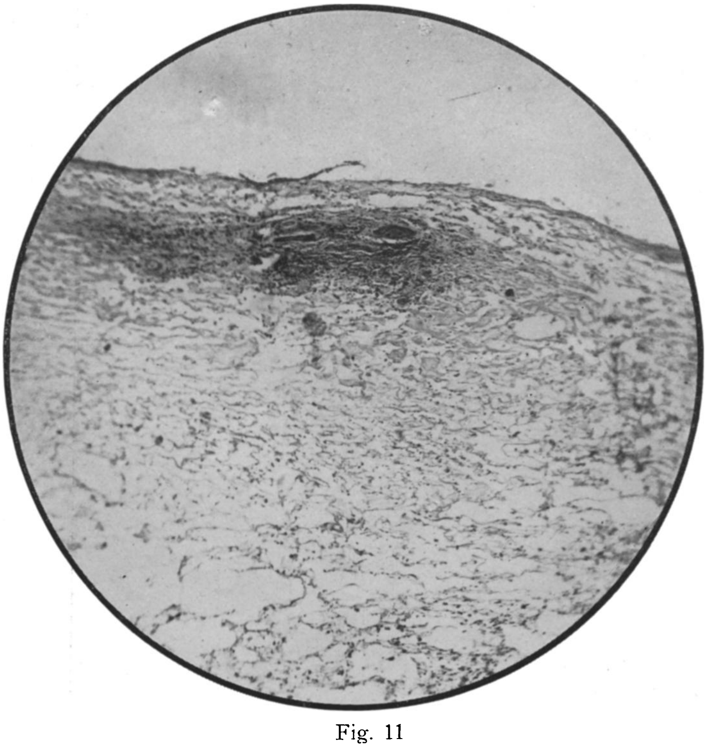
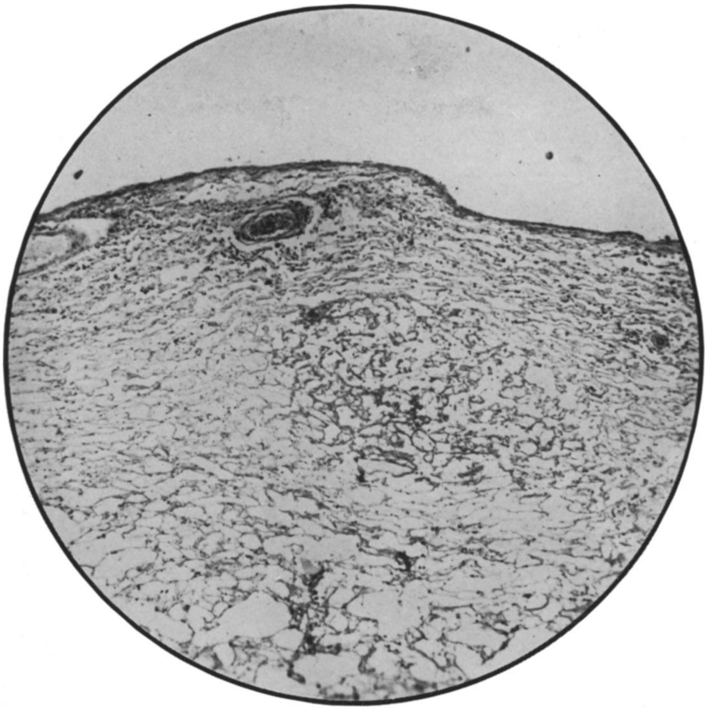


Fig. 11

PLATE 8



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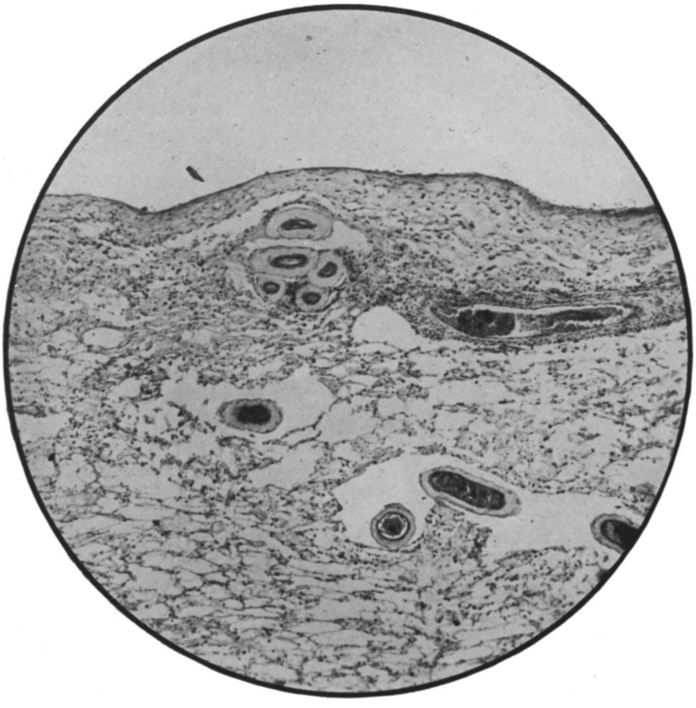


Fig. 13

PLATE 9

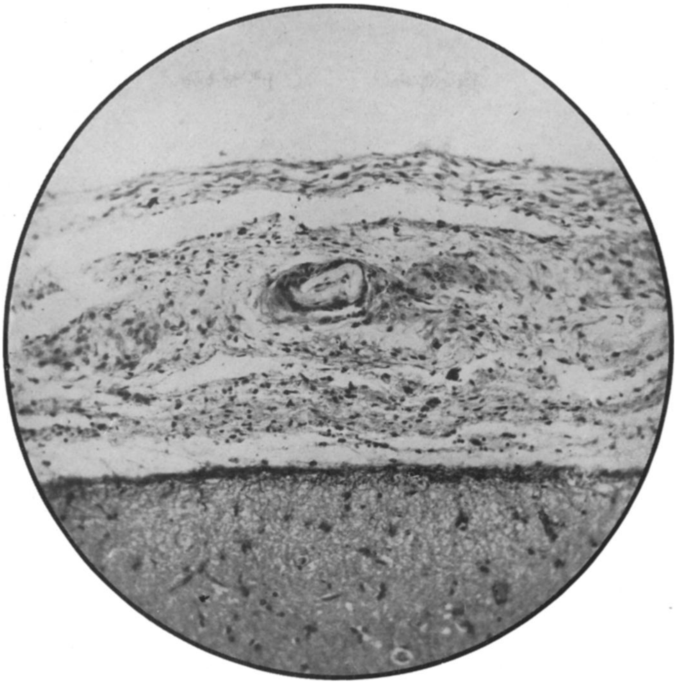


Fig. 14

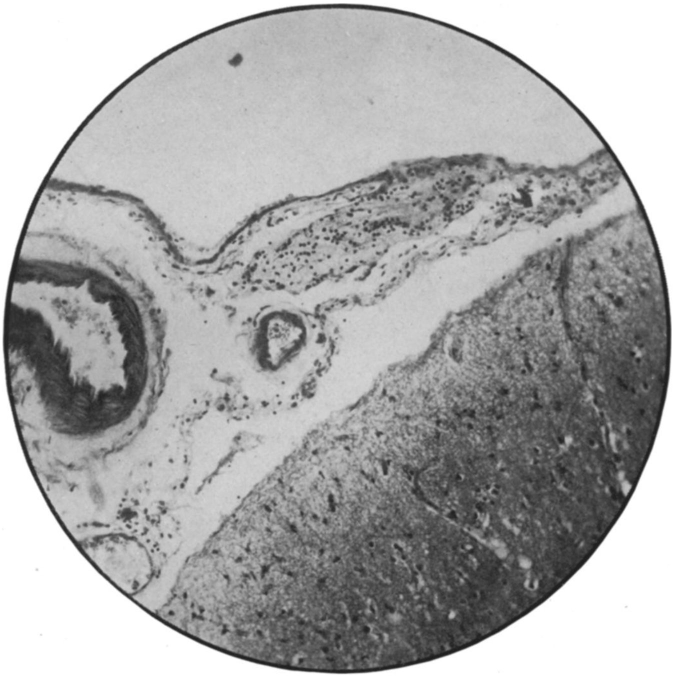


Fig. 15

Plate 10

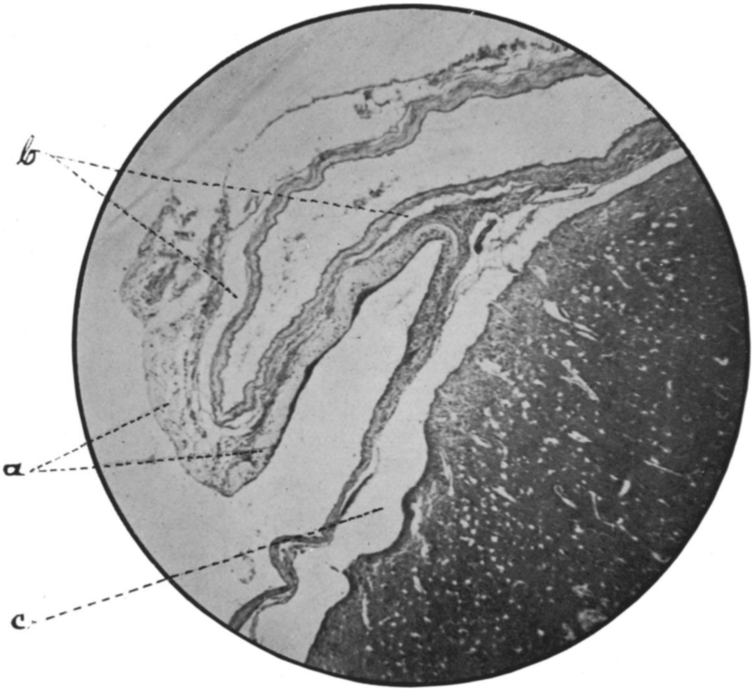
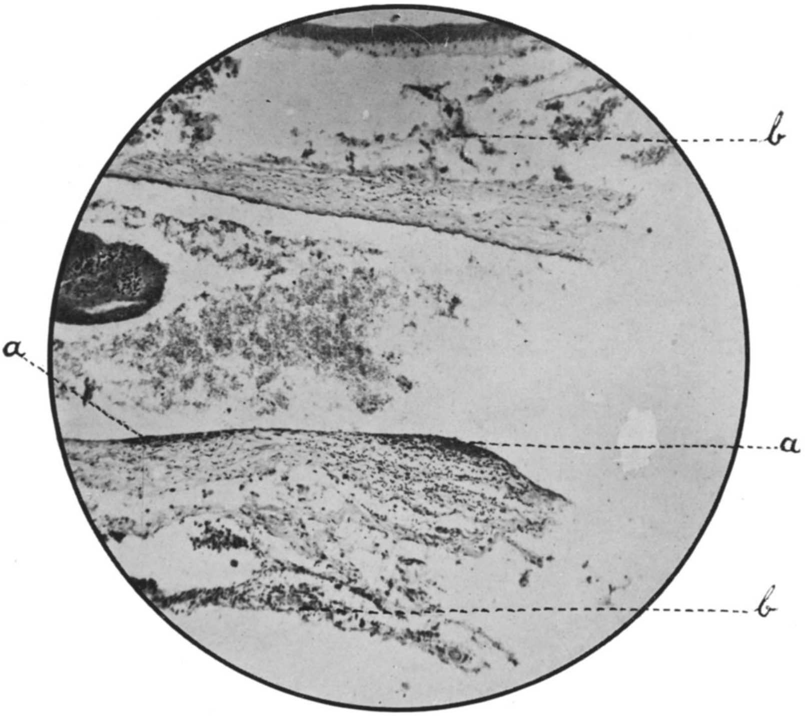


Fig. 16



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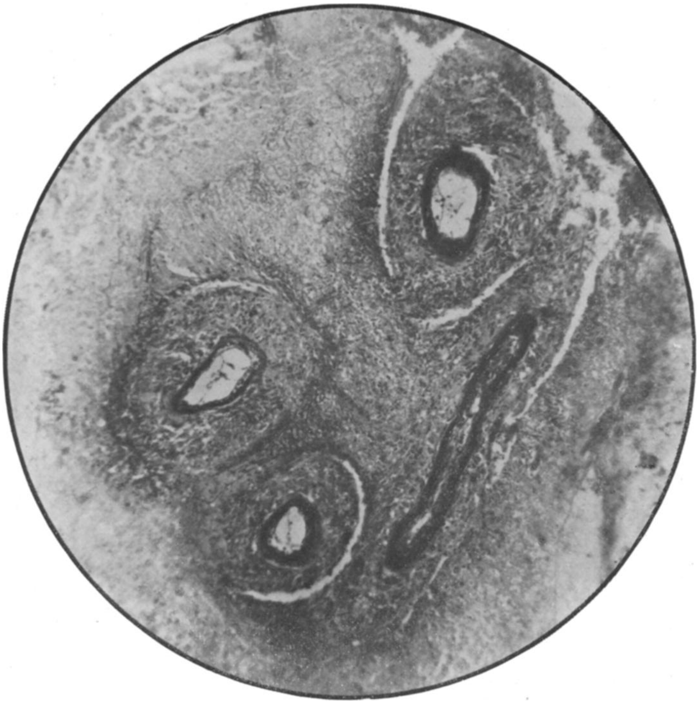

Fig. 18

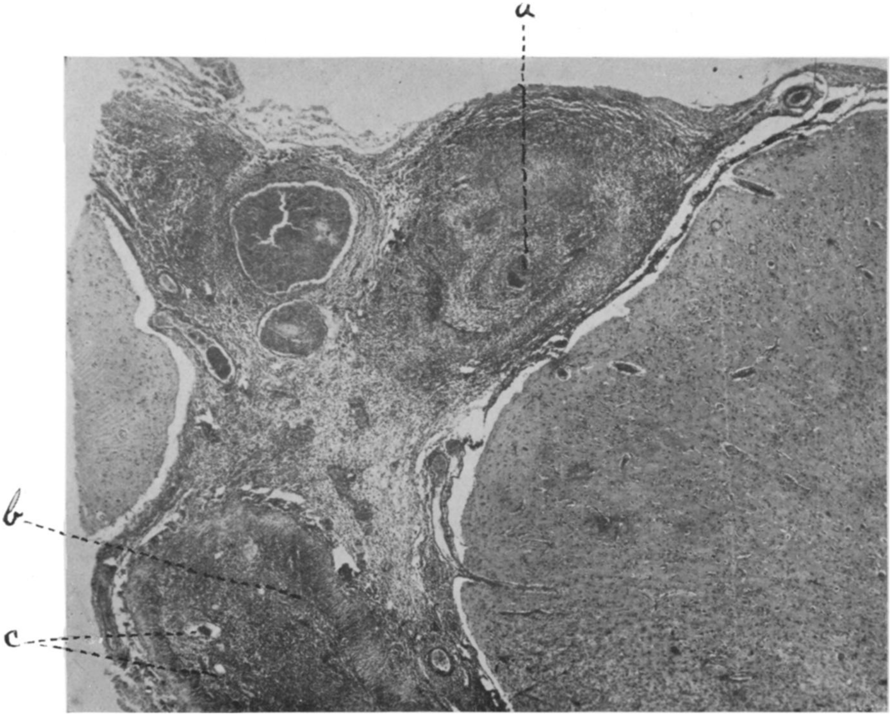

Fig. 19